Oregon Greater Sage-Grouse Population Monitoring: 2019 Annual Report

OREGON
Fish & Wildlife

September 2019

Oregon Department of Fish and Wildlife

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TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS (Continued)

PAGE

LIST OF TABLES

PAGE

LIST OF FIGURES

PAGE

Executive Summary

During the 2019 greater sage-grouse (*Centrocercus urophasianus*) breeding season, 1,737 aerial and ground lek surveys were conducted at 755 individual lek sites comprising 489 lek complexes. Surveys were conducted at 64.0% of known lek sites in the state. Survey effort during 2019 declined 5.8%, 7.7%, and 6.9% from 2018 levels, in terms of number of surveys conducted, number of leks surveyed, and number of complexes surveyed, respectively. Despite the decline, this constitutes the second highest survey effort accomplished in Oregon to date. Results from these surveys indicate the sage-grouse spring breeding population in Oregon declined by -24.9% between 2018 and 2019, to 13,827 estimated individuals (±1,028 individuals). This constitutes the lowest sage-grouse population estimate in Oregon during the 1980 – 2019 analysis period. Magnitude of population trend was relatively consistent across BLM districts. Burns District, Lakeview District, Prineville District, and Vale District all exhibited declines between 17.1% (Vale), and 35.4% (Burns). Analysis of the Baker BLM Resource Area indicated at 26.1% population increase, but upon closer examination of the data, this result appears to be spurious, and due to changes in lek size distribution, with the actual population trend likely stable in 2019.

Overview and Spring Population Monitoring Methods

Counts of male sage-grouse displaying on leks (communal breeding sites) during the spring breeding season have been used to generate indices of sage-grouse population trend since the 1940s (Patterson 1952), and remain the most widely used method to monitor sage-grouse populations range-wide (McCafferey et al. 2016). Monitoring of some sage-grouse leks in Oregon began in the 1940s, with survey efforts increasing in the state after 1980 (ODFW 2011). ODFW adopted a standardized lek survey methodology in 1996, ensuring consistent data quality and allowing data comparison across the state. ODFW has generated BLM District-specific spring sage-grouse population estimates since 2013. Prior to 2013 yearly population estimates were conducted at the scale of ODFW Wildlife Management Units (WMUs). While WMU level estimates of fall sage-grouse populations are still developed to inform sage-grouse hunting tag allocation, the decision to generate spring estimates at the scale of BLM Districts reflects that the BLM is the primary land manager in much of Oregon sage-grouse range, and thus the agency with the greatest ability to affect sage-grouse habitat quality and population trends. Beginning in 2015, effort has been expended to survey an increased number of leks in Priority Areas for Conservation (PACs; synonymous with ODFW Core Areas), to facilitate the implementation of PAC-level adaptive management population triggers required under the BLM Greater Sage-Grouse Approved Resource Management Plan Amendment (ARMPA). This increased survey effort is supported by a Cooperative Funding Agreement between the BLM and ODFW which supports additional seasonal lek survey positions, as well as increased aerial lek survey and telemetry effort. ODFW provides lek survey results to the BLM following the lek survey period, the BLM then generates estimates of sage-grouse population trend at the PAC level and reports on PAC level population trends and adaptive management triggers. Survey effort and trend in male lek attendance are reported at the PAC level in Appendix I, however, due to differences in trend estimation methodology, the PAC level information presented here should not be conflated

with BLM-generated estimates of PAC population trend, and adaptive management trigger analysis, as required by the ARMPA. The data regarding PAC-specific trends are presented here for informational purposes only.

Sage-grouse leks and lek complexes (a group of closely allied leks, within 1 mile of each other, between which a set of males may move; ODFW 2011) are monitored between 15 March and 30 April to obtain counts of breeding male sage-grouse. In a collaborative effort, biologists with ODFW, BLM, USFWS, Burns Paiute Tribe, as well as volunteers under the ODFW Adopt-a-Lek Program (Appendix II), visit leks from approximately 30 minutes before sunrise until approximately 2 hours after sunrise and count all male sage-grouse visible on a lek. Counts of all individual leks comprising a complex which are conducted on the same day are summed and treated as a single unit during analysis. Hereafter, lek complex will be used to refer to the sample unit in this report, whether a single lek or multiple leks compose a complex. Due to variability in male attendance at leks throughout the breeding season, a subset of lek complexes are counted up to 4 times per season, with individual counts separated by 7-10 days. Using this methodology, a subset of lek complexes are counted in each BLM district with extant sage-grouse populations, with minimum spring population estimates conducted by ODFW at the scale of BLM district (Table 1, Figure 1). In the case of the Vale District, population estimates are generated separately for the Baker Resource Area and the remainder of the District, due to the small size of the Baker Resource Area (RA) population, and its isolation from the other populations in the District.

Minimum spring population estimates are generated from maximum counts of males at each lek complex using a stratified random estimator (Krebs 1994). Lek complexes are assigned to one of five strata, based on the 8-year average of maximum male attendance: inactive (0 males), small (1-10 males), medium (11-25 males), large (26-50 Males), and XL (>50 males; ODFW 2011). To assign lek complexes not counted during the current year to the appropriate stratum, lek complex attendance is estimated by adjusting the most recent male count by the average proportional change in lek complex size for counted leks, in the relevant BLM district, between the count year and the current year (ODFW 2011). Mean lek complex attendance per stratum is then calculated based solely on actual counts, and adjusted by 0.75 to obtain an estimate of the actual mean number of males per lek complex per stratum, based on the assumption that only 75% of males reliably attend leks in a given year (Jenni and Hartzler 1978, Emmons and Braun 1984, Walsh et al. 2004, ODFW 2011). The adjusted estimate of mean males per lek complex per stratum is then multiplied by the 5-year statewide average sex ratio estimated from hunter-harvested wings (Appendix III), to generate an estimate of the mean number of females per lek complex per stratum. The sum of females and males per lek complex per stratum is then generated and an estimate of individuals per lek complex is calculated, weighted based on the proportion of lek complexes comprising each stratum. The final spring population estimate for each BLM district/RA is calculated as the total number of known active lek complexes in a given BLM district multiplied by the weighted average lek complex size in that district (Krebs 2004). Confidence limits on these estimates are generated based on variability in counts per stratum and number of lek complexes surveyed within each stratum (Krebs 2004).

Methods for projecting sage-grouse population estimates back in time contain multiple assumptions regarding lek formation and extinction rates (ODFW 2011), for this reason no attempt is made in this report to back project estimated sage-grouse populations by BLM district

to those years prior to 2013, when population estimates were conducted at the scale of WMUs. Rather, trends in population at the scale of BLM districts between 1980 and 2019 are reported following the methodology of Schroeder et al. (2000). An index of population trend by BLM district, between 1980 and 2019, is reported as the percentage of 2019 male attendance during Year *t*, solely at leks counted during both 2019 and Year *t*. For example, if a set of leks is counted in both 2019 and Year *t*, and the count totals are 100 males during 2019, and 120 males during Year *t*, the population index during Year *t* = 120%.

Throughout this report, change in lek size over time is depicted using the average number of males counted per active lek in a given analysis unit. While this metric is generally reliable, caution should be taken when examining these graphs during the 1980 – 1996 period. In many areas few leks were counted prior to 1996 (Figure 2), and often the leks counted were large. As knowledge of lek distribution across the state has increased, many relatively small leks have been identified and surveys of those leks have increased in recent years. The recent routine counting of these smaller leks has likely corrected bias in the males/active lek metric, reducing the average size of counted leks, and thus potentially indicating an artificial decline in lek size in some areas.

While ODFW generates point estimates of the sage-grouse population in Oregon and confidence intervals around those estimates using the statistical method described above, caution should be used when making inference based on these estimates. Lek counts are an index of population size and the true relationship between the index and the population size is unknown (Walsh et al. 2004, ODFW 2011). Due to the high proportion of leks surveyed in a given year, and consistency in monitoring and analysis methodologies over the previous 23 years, ODFW is confident that the long-term population trends reported herein are accurate and scientifically supported, however the actual number of sage-grouse in a given BLM district remains unknown.

Table 1. BLM districts/Resource Areas containing current sage-grouse populations, and the percent of the 2019 spring sage-grouse population contained in each analysis unit.

BLM District/Resource Area	% Of 2019 Population
Baker Resource Area[a]	3.9
Burns District	17.9
Lakeview District	25.4
Vale District[a]	42.7
Prineville District	10.2

[a]The Baker Resource Area is analyzed separately from the remainder of the Vale BLM District, due to dissimilarity in population size and trajectory

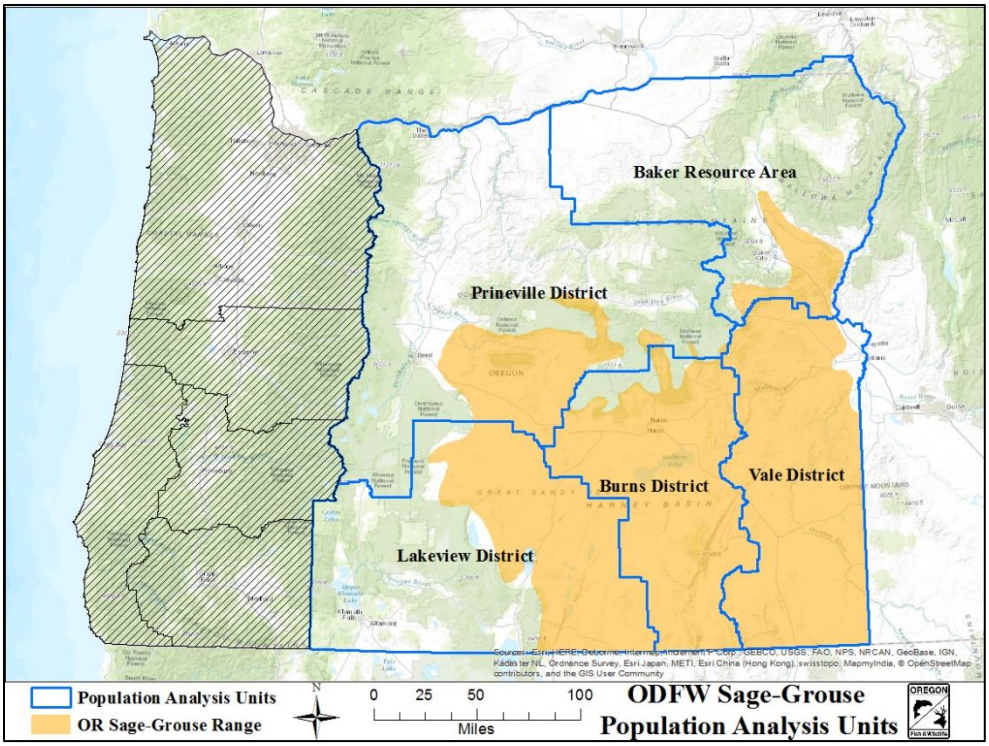

Figure 1. Oregon BLM Districts/Resource Areas containing current sage-grouse populations, and functioning as analysis units for spring population estimation in Oregon. The Baker Resource Area is analyzed separately from the remainder of the Vale BLM District, due to dissimilarity in population size and trajectory.

Lek Monitoring Effort and Population Estimates

Statewide

An abnormally late winter, which saw significant snow remain at low elevations until well after 15 March, appeared to delay the onset of breeding behavior, and hampered access to leks during the early portion of the survey period. However, due to additional capacity, and excellent effort by all partners, statewide lek survey effort during 2019 was the second highest accomplished to date in Oregon (Figure 2; Table 2). ODFW and partners completed 1,733 ground counts and 4 aerial counts. Surveys were conducted at 755 leks comprising 489 lek complexes. Of the 1,180 individual leks, and 796 lek complexes known to exist or have existed in the state, 64.0% and 61.4%, respectively, were surveyed during 2019. On average each lek was surveyed 2.3 times. Dedicated aerial surveys (Appendix IV), and incidental observations during ground surveys helped expand knowledge of sage-grouse distribution; 3 leks were either located or surveyed for the first recorded time in 2019.

The estimated spring greater sage-grouse population in Oregon during 2019 was 13,827 individuals (95% CI: 12,799 – 14,855 individuals), a -24.9% decline from 2018 (2018 Estimate = 18,420 individuals). This represents the third year of statewide population decline since 2016, and the lowest estimated sage-grouse population in Oregon during the analysis period of 1980 –

2019. The population during 2019 was 52.9% below the 2003 baseline population estimate of 29,237 individuals (Figure 3). Data collected since the 2011 Oregon Greater Sage-Grouse Conservation Assessment and Strategy (hereafter: 2011 Conservation Assessment), suggests a statistically significant decline in the annual average number of males counted per active complex of -0.2 birds per year since 1980 (Multiple $R^2 = 0.17$, p-value < 0.01; Figure 3).

Baker Resource Area

Lek survey effort in the Baker Resource Area increased slightly from 2018 levels during 2019. Due to limited private land access it is not anticipated that survey effort in the Baker Resource Area will increase substantially in future years. Survey effort in 2019 was the second highest ever accomplished in the area (Figure 4; Table 3). During 2019, 159 ground surveys were conducted at 52 leks comprising 35 complexes. This constitutes 61.2% of the 85 leks, and 59.3% of the 59 complexes known to exist or have existed in the Resource Area. Survey effort per lek was high, with each lek receiving, on average, 3.06 surveys during the monitoring season. No new leks or complexes were discovered in the area during 2019.

The estimated spring sage-grouse population in the Baker Resource Area was 541 individuals (95% CI: 380 – 702 individuals), a 26.1% increase from 429 individuals in 2018. Unfortunately, this apparent increase in estimated population is likely an artifact of the analysis methodology used to generate population estimates. The average size of leks in analysis strata increased not because of increases in lek size, but rather due to removal of inactive leks from analysis strata following multiple years of 0 counts. The Krebs random stratified estimator used to generate population estimates does not perform well in small populations such as that existing in the Baker Resource Area. During 2019, observed male attendance at lek complexes counted during 2018 increased only 1.1% from 92 to 93 observed males. While the sage-grouse population in the Baker Resource Area remains above 2014 levels ($n_{2014} = 402$ individuals), this area has experienced a long-term population decline, and has remained stagnant in recent years. The five-year average annual change in male lake complex attendance between 2014 and 2019 is -2.0%, and a -75.6% decline in male lek complex attendance has been observed since 2005 at complexes counted during both 2005 and 2019 ($n_{2005} = 238$, $n_{2019} = 58$; Figure 5). Male attendance at complexes monitored in both 2003 and 2019 indicates that the population in the Baker Resource Area is currently 75.4% below the 2003 baseline level ($n_{2003} = 236$, $n_{2019} = 58$). Data collected since the 2011 Conservation Assessment suggests a significant reduction in the average size of lek complexes since 1996, with average males per active complex declining by -0.56 individuals per year over this period (Multiple $R^2 = 0.54$, p-value < 0.01; Figure 5).

Table 2. **Oregon statewide** greater sage-grouse lek complex survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1980 – 2019.

	1980-84		1985-89		1990-94		1995-99		2000-04		2005-09		2010-14		2015-18		2019	
Variable	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*
Known Complexes	140.00	*6.32*	220.40	*20.60*	326.00	*16.41*	486.00	*21.23*	605.60	*13.51*	690.00	*8.04*	733.00	*6.44*	782.75	*7.29*	796.00	-
Complexes Counted	52.00	*6.02*	67.60	*10.36*	94.00	*12.09*	164.20	*8.75*	200.80	*11.05*	266.60	*16.05*	294.40	*26.74*	484.75	*22.49*	489.00	-
Proportion Complexes Counted	0.38	*0.06*	0.30	*0.03*	0.28	*0.02*	0.34	*0.02*	0.33	*0.01*	0.39	*0.02*	0.40	*0.03*	0.62	*0.03*	0.61	-
Active Complexes	27.20	*3.40*	48.20	*7.27*	73.00	*12.68*	129.20	*4.12*	144.60	*7.75*	178.80	*6.92*	178.60	*10.32*	250.50	*4.53*	244.00	-
Males Per Complex	13.39	*2.46*	19.13	*2.06*	19.19	*1.96*	12.34	*0.54*	17.03	*0.92*	15.24	*2.61*	11.86	*1.61*	9.69	*0.52*	6.69	-
Males Per Active Complex	23.44	*1.79*	26.61	*2.28*	25.28	*2.42*	15.61	*0.59*	23.78	*1.82*	22.40	*3.59*	18.89	*1.72*	18.70	*0.82*	13.40	-
Proportion Change - Male Attendance	0.01	*0.10*	0.08	*0.08*	-0.08	*0.07*	-0.05	*0.07*	0.09	*0.02*	-0.09	*0.10*	0.00	*0.10*	0.04	*0.09*	-0.23	-

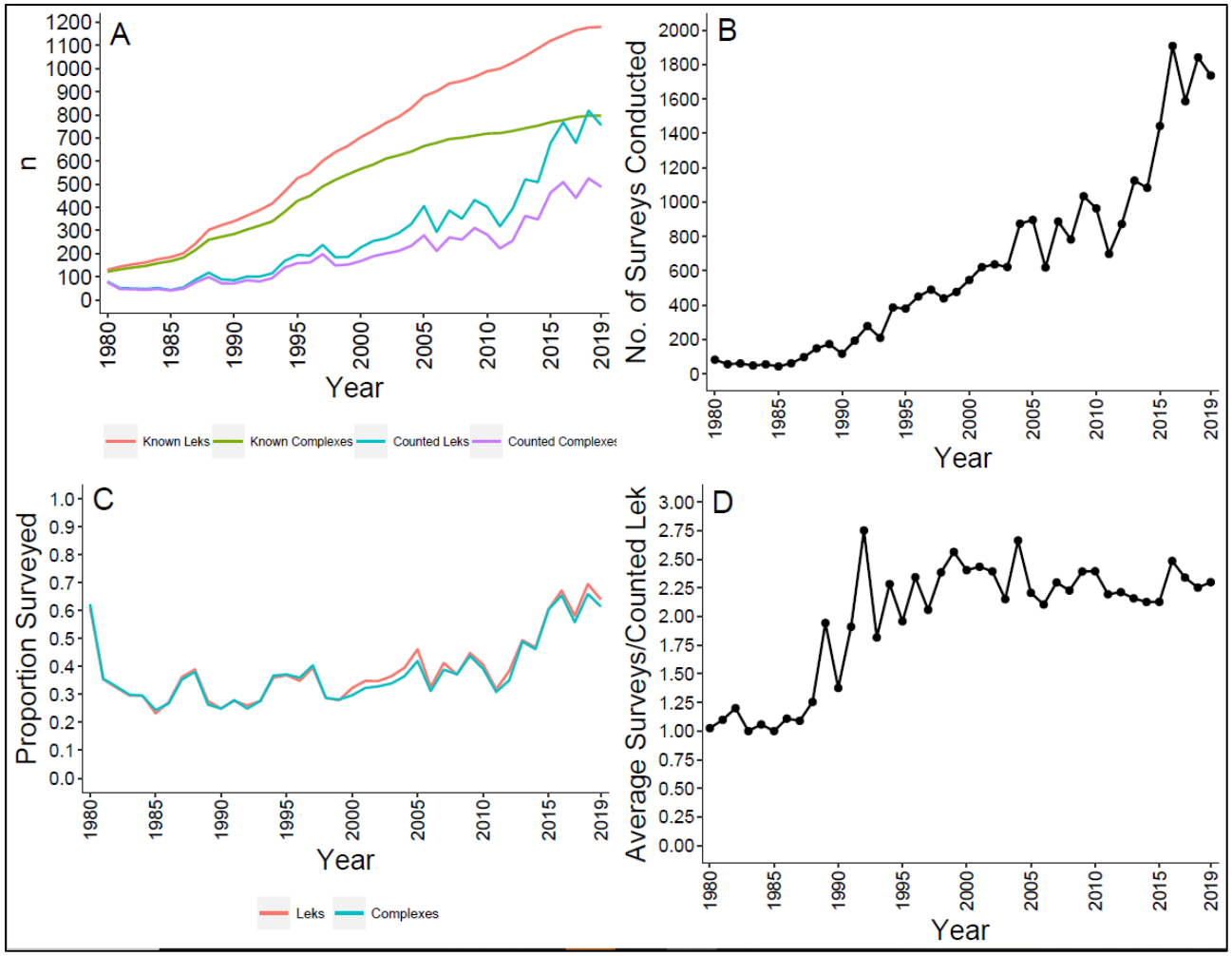

Figure 2. **Oregon statewide** greater sage-grouse survey effort statistics, 1980 – 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

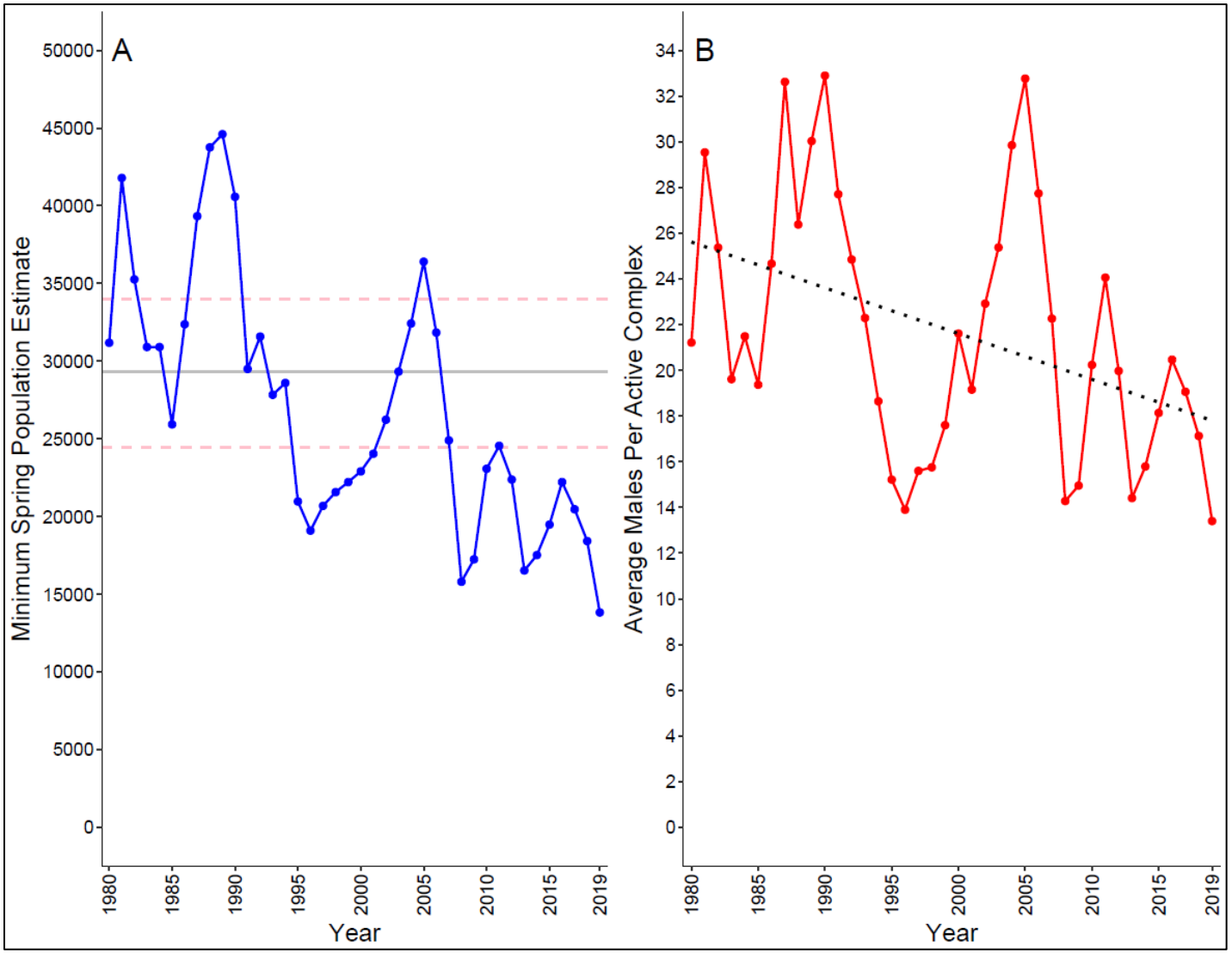

Figure 3. Greater sage-grouse population trends in **Oregon**, 1980 – 2019. A - Estimated spring breeding population of greater sage-grouse, gray line indicates 2003 baseline population level of 29,327 individuals, pink dotted lines indicate the 95% confidence interval around the 2003 baseline estimate. B - Change in average lek complex size (males per active lek complex).

Table 3. **Baker BLM Resource Area** greater sage-grouse lek complex survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1996 – 2019.

	1996-99		2000-04		2005-09		2010-14		2015-18		2019	
Variable	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*
Known Complexes	24.00	*3.39*	40.60	*1.17*	43.40	*0.68*	51.40	*0.40*	57.00	*1.94*	59.00	-
Complexes Counted	12.25	*1.49*	15.00	*2.61*	18.20	*4.07*	15.80	*1.46*	31.00	*5.89*	35.00	-
Proportion Complexes Counted	0.52	*0.04*	0.37	*0.07*	0.41	*0.08*	0.31	*0.03*	0.54	*0.09*	0.59	-
Active Complexes	8.00	*0.82*	12.40	*2.73*	13.40	*0.75*	10.40	*1.17*	9.75	*1.19*	10.00	-
Males Per Complex	13.61	*1.21*	15.22	*2.02*	12.49	*2.79*	6.86	*1.03*	3.91	*0.91*	2.91	-
Males Per Active Complex	20.46	*1.11*	18.99	*2.39*	14.56	*2.51*	10.26	*1.01*	11.60	*1.01*	10.20	-
Proportion Change - Male Attendance	0.08	*0.05*	0.02	*0.12*	-0.16	*0.05*	-0.10	*0.12*	0.02	*0.15*	0.02	-

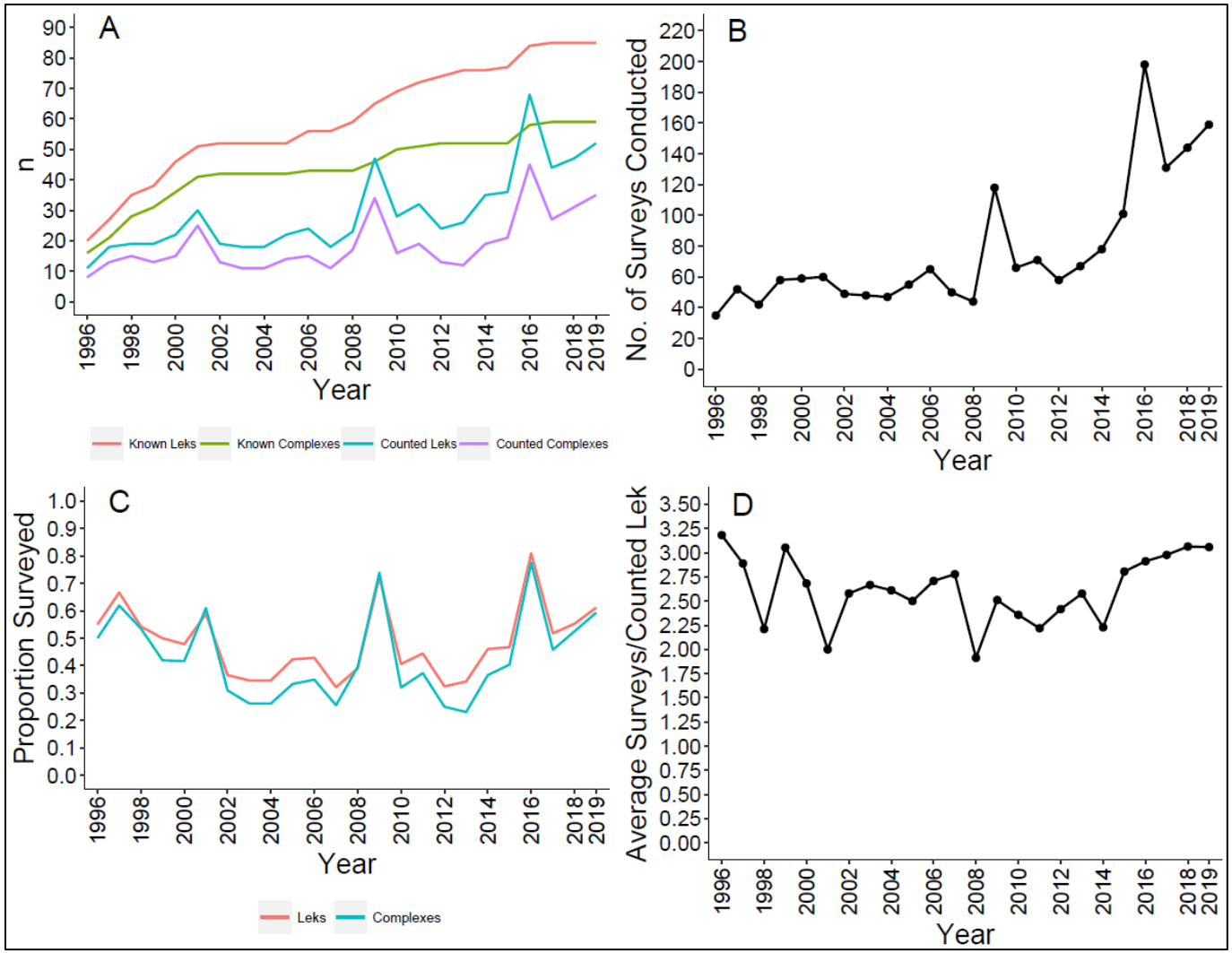

Figure 4. **Baker BLM Resource Area** greater sage-grouse survey effort statistics, 1996 – 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

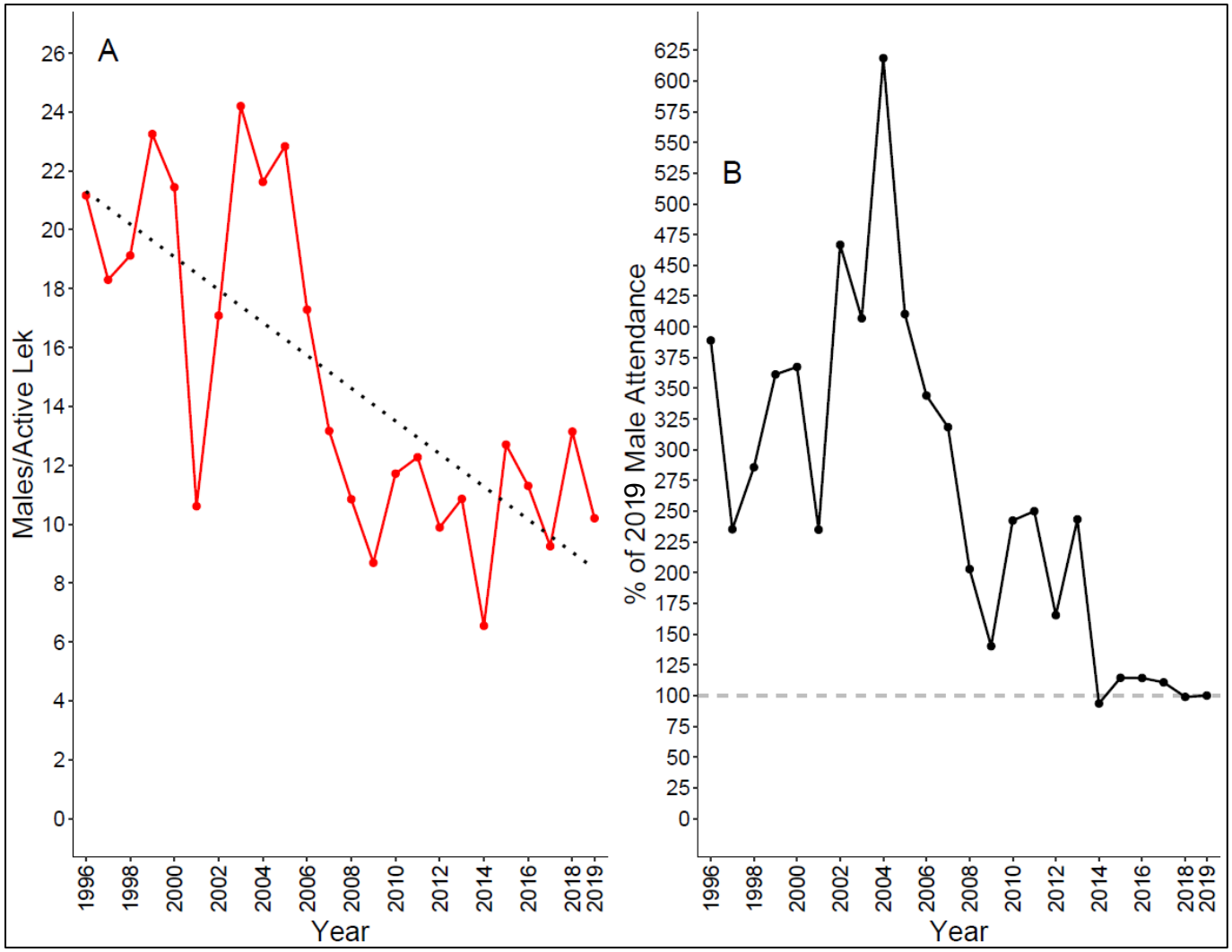

Figure 5. Greater sage-grouse population trend in the **Baker BLM Resource Area,** 1996 – 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

Burns District

Due to late winter snow pack inhibiting lek access, survey effort for the Burns District during 2019 was the lowest recorded since 2014, but remained above survey effort goals for the district (Table 4; Figure 6). During 2019, 295 ground surveys, were conducted at 154 leks comprising 104 complexes. This constitutes 71.6% of the 215 leks, and 72.2% of the 144 complexes known to exist or have existed in the district. Survey effort per lek declined slightly from 2018 levels, but remained adequate (Surveys/Lek: 2018 = 1.97, 2019 = 1.91). Two spurious lek locations were removed from the database in the district.

The estimated spring sage-grouse population in the Burns District during 2019 was 2,470 individuals (95% CI: 2,284 – 2,656 individuals), a -35.4% decline from 3,823 individuals in 2018. Observed male attendance at lek complexes counted during both 2018 and 2019 declined -34.0% from 765 to 505 observed males. This represents the third consecutive year of population decline in the district (Figure 7). Observed male attendance during 2019 is -70.6% below the 2003 baseline level (n_{2003} = 652, n_{2019} = 192), at complexes counted during both 2003 and 2019 (Figure 7). Data collected since the 2011 Conservation Assessment suggests a significant reduction in average lek complex size since 1981, with the number of males per active complex declining by -0.52 individuals per year over this period (Multiple R^2 = 0.31, p-value <0.01; Figure 7).

Lakeview District

Late winter snow pack also affected lek access and survey effort in the Lakeview District during 2019, with survey effort at its lowest level since 2016, however survey effort remained above goals for the district (Table 5; Figure 8). During 2019, 396 ground surveys, and 4 aerial surveys were conducted at 181 leks comprising 122 complexes. This constitutes 59.2% of the 306 leks, and 60.4% of the 202 complexes known to exist or have existed in the district. Survey effort per lek declined slightly between 2018 and 2019 (Surveys per Lek: 2018 = 2.53, 2019 = 2.21). Two previously unknown leks were discovered during 2019 in the district (1 aerial discovery, 1 ground discovery).

The estimated spring sage-grouse population in the Lakeview District was 3,507 individuals (95% CI: 3,135 – 3,879 individuals), a -33.9% decline from 5,304 individuals in 2018. During 2019, observed male attendance at complexes also counted during 2018 declined -30.8%, from 803 to 556 observed males. As was observed at the statewide level, this was the third consecutive year of population decline in the district, with the lowest population level recorded in the district since population estimation at the district level began in 2014. Observed male attendance was 64.7% below the 2003 baseline level (n_{2003} = 1,392, n_{2019} = 492), at complexes counted during both 2003 and 2019 (Figure 9). Data collected since the 2011 Conservation Assessment suggest a small, non-significant reduction in average lek complex size since 1980, with average males per lek complex declining by -0.13 males per year over this period (Multiple R^2 = 0.03, p-value = 0.28; Figure 11).

Table 4. **Burns BLM District** greater sage-grouse lek complex survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1981 – 2019.

	1981-84		1985-89		1990-94		1995-99		2000-04		2005-09		2010-14		2015-18		2019	
Variable	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*
Known Complexes	30.75	*1.44*	54.40	*6.68*	75.80	*1.16*	83.00	*1.87*	95.20	*3.75*	120.00	*3.77*	131.80	*1.39*	142.75	*0.55*	144.00	-
Complexes Counted	15.00	*0.82*	21.60	*4.32*	18.80	*0.92*	25.20	*4.14*	30.20	*3.43*	39.80	*7.32*	48.00	*3.99*	102.00	*6.91*	104.00	-
Proportion Complexes Counted	0.49	*0.05*	0.41	*0.07*	0.25	*0.02*	0.30	*0.05*	0.31	*0.03*	0.33	*0.05*	0.36	*0.03*	0.71	*0.05*	0.72	-
Active Complexes	11.50	*1.32*	14.40	*0.40*	16.80	*0.58*	20.00	*1.76*	24.40	*2.54*	29.00	*4.00*	31.40	*1.66*	58.25	*1.66*	52.00	-
Males Per Complex	22.70	*1.67*	26.86	*5.44*	32.76	*2.18*	12.97	*1.49*	19.10	*1.89*	19.59	*5.47*	13.04	*2.07*	10.67	*1.55*	5.77	-
Males Per Active Complex	30.19	*2.65*	36.70	*5.64*	36.86	*3.49*	15.35	*0.88*	23.20	*1.46*	24.95	*5.81*	19.21	*2.26*	18.36	*1.70*	11.54	-
Proportion Change - Male Attendance	-0.07	*0.02*	0.12	*0.12*	-0.04	*0.08*	-0.06	*0.13*	0.12	*0.10*	-0.10	*0.14*	0.00	*0.13*	0.03	*0.11*	-0.34	-

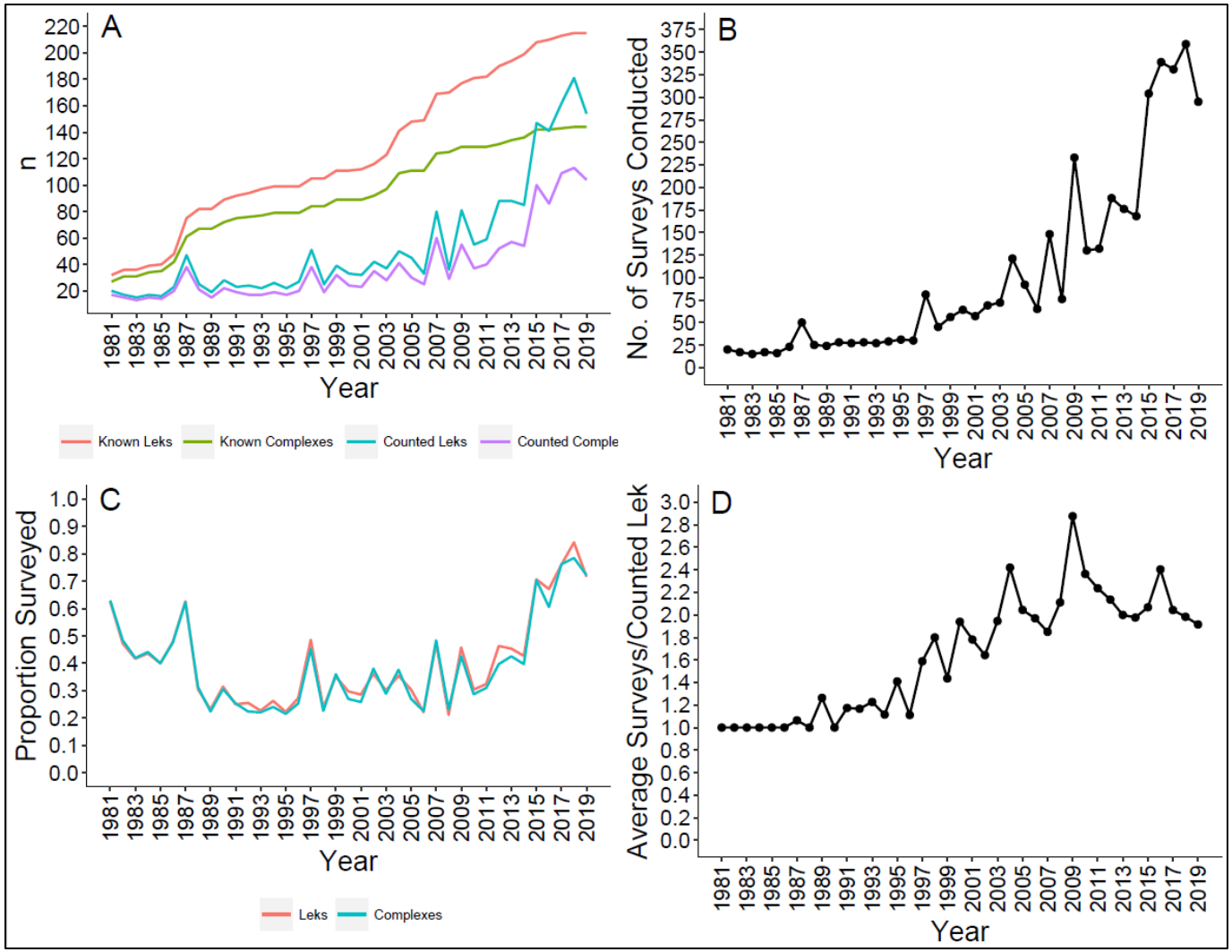

Figure 6. **Burns BLM District** greater sage-grouse survey effort statistics, 1981 – 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

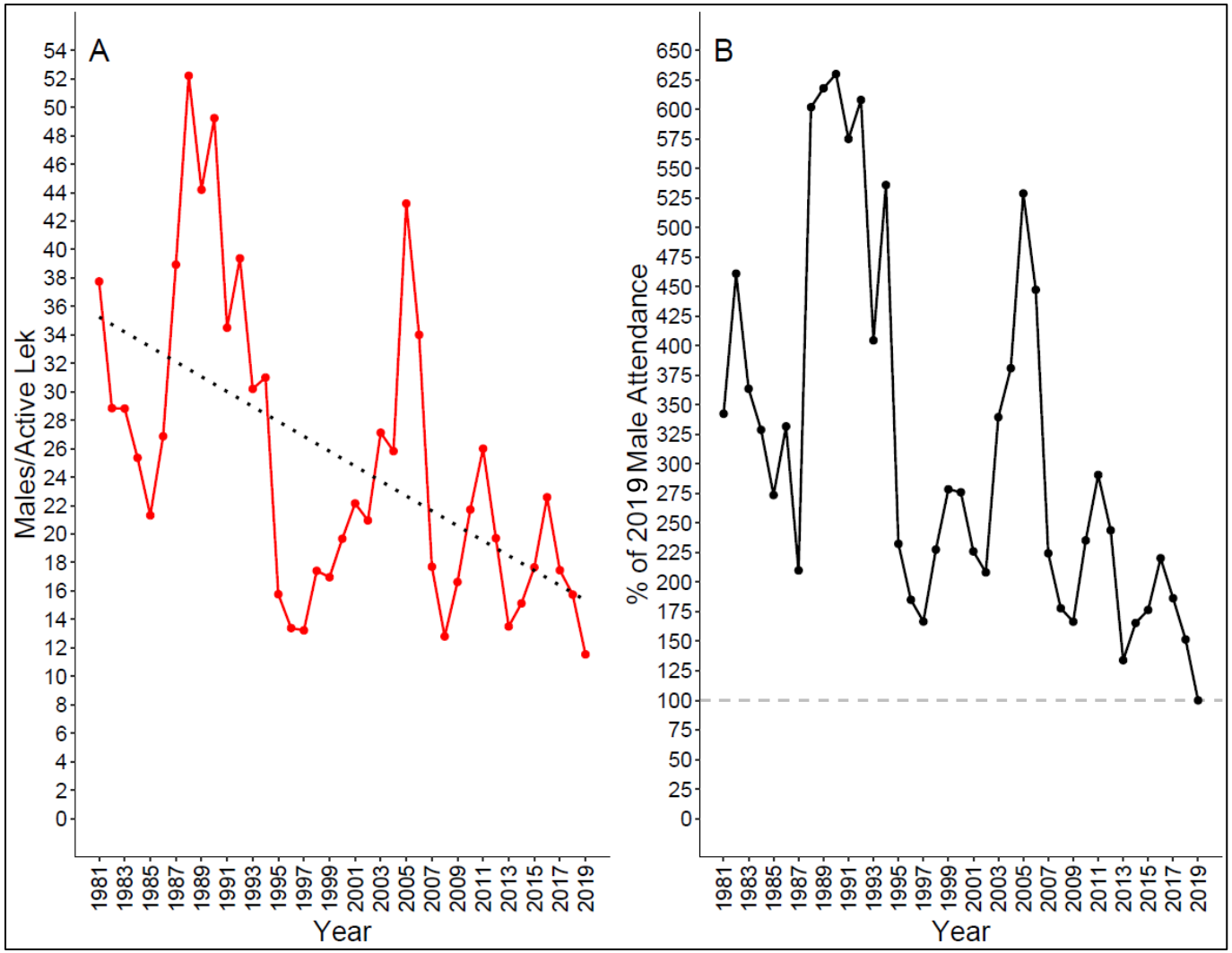

Figure 7. Greater sage-grouse population trend in the **Burns BLM District,** 1981 – 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year t, and 2019.

Table 5. **Lakeview BLM District** greater sage-grouse lek complex survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1980 – 2019.

	1980-84		1985-89		1990-94		1995-99		2000-04		2005-09		2010-14		2015-18		2019	
Variable	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*
Known Complexes	74.00	*0.95*	90.20	*5.85*	117.60	*1.12*	130.80	*0.20*	162.00	*8.58*	184.00	*0.84*	191.00	*1.30*	197.50	*1.80*	202.00	-
Complexes Counted	23.80	*7.83*	21.00	*3.45*	25.20	*1.56*	30.20	*2.60*	81.80	*9.83*	79.00	*3.96*	80.20	*6.67*	115.50	*8.54*	122.00	-
Proportion Complexes Counted	0.33	*0.11*	0.23	*0.03*	0.21	*0.01*	0.23	*0.02*	0.50	*0.04*	0.43	*0.02*	0.42	*0.03*	0.58	*0.04*	0.60	-
Active Complexes	10.60	*1.54*	13.80	*1.46*	16.60	*2.20*	23.80	*2.15*	52.80	*6.08*	48.20	*2.29*	49.20	*3.02*	59.40	*4.39*	52.00	-
Males Per Complex	14.50	*3.52*	22.90	*3.20*	20.18	*2.52*	15.93	*1.62*	20.10	*1.38*	20.14	*3.59*	14.56	*2.06*	10.39	*1.71*	5.55	-
Males Per Active Complex	22.65	*2.49*	33.47	*3.84*	30.98	*2.28*	20.02	*1.76*	31.39	*3.01*	33.33	*6.56*	23.19	*2.61*	20.08	*2.61*	13.02	-
Proportion Change - Male Attendance	0.16	*0.17*	0.04	*0.08*	-0.10	*0.11*	-0.02	*0.12*	0.17	*0.04*	-0.13	*0.09*	-0.02	*0.11*	-0.04	*0.13*	-0.31	-

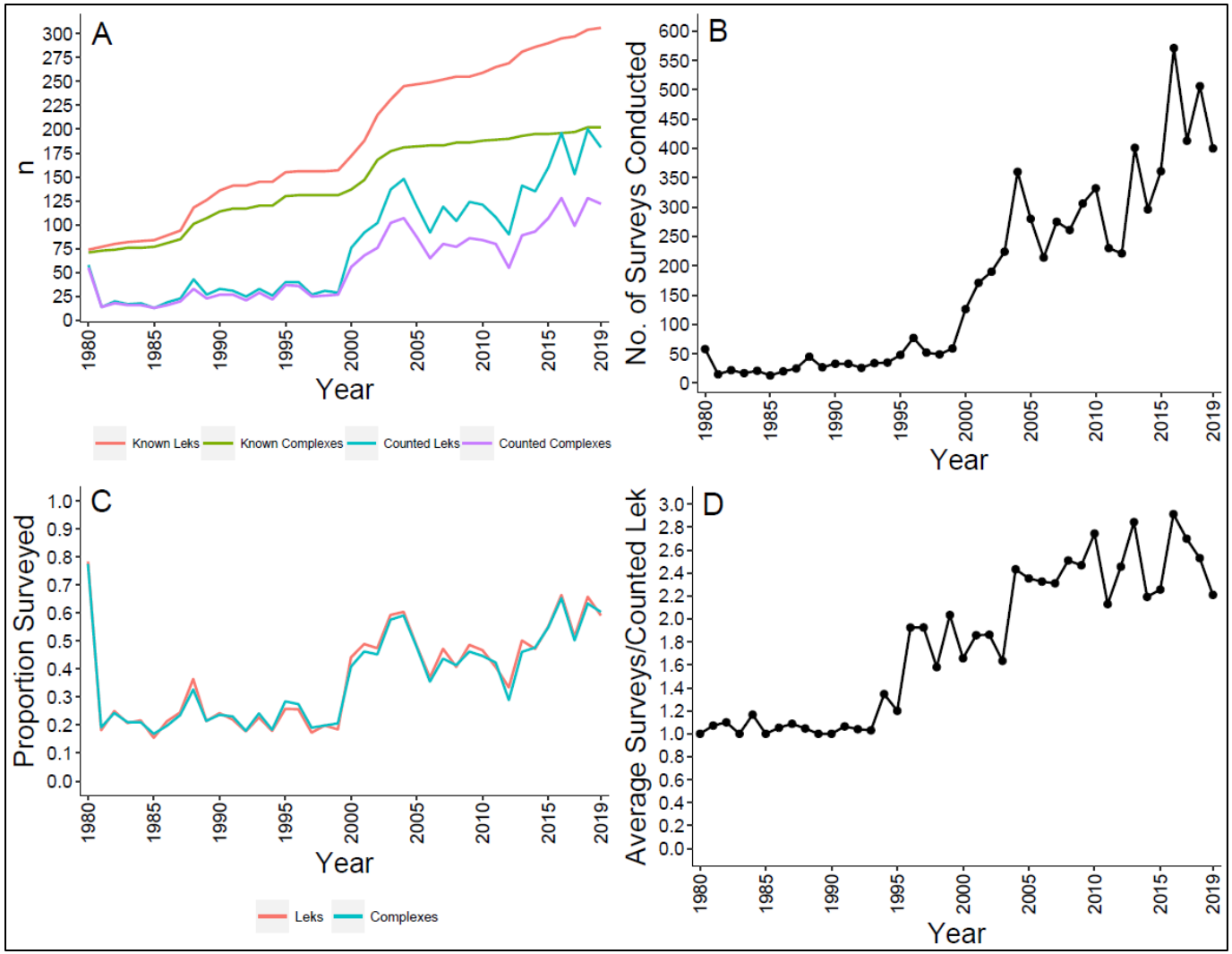

Figure 8. **Lakeview BLM District** greater sage-grouse survey effort statistics, 1980 – 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

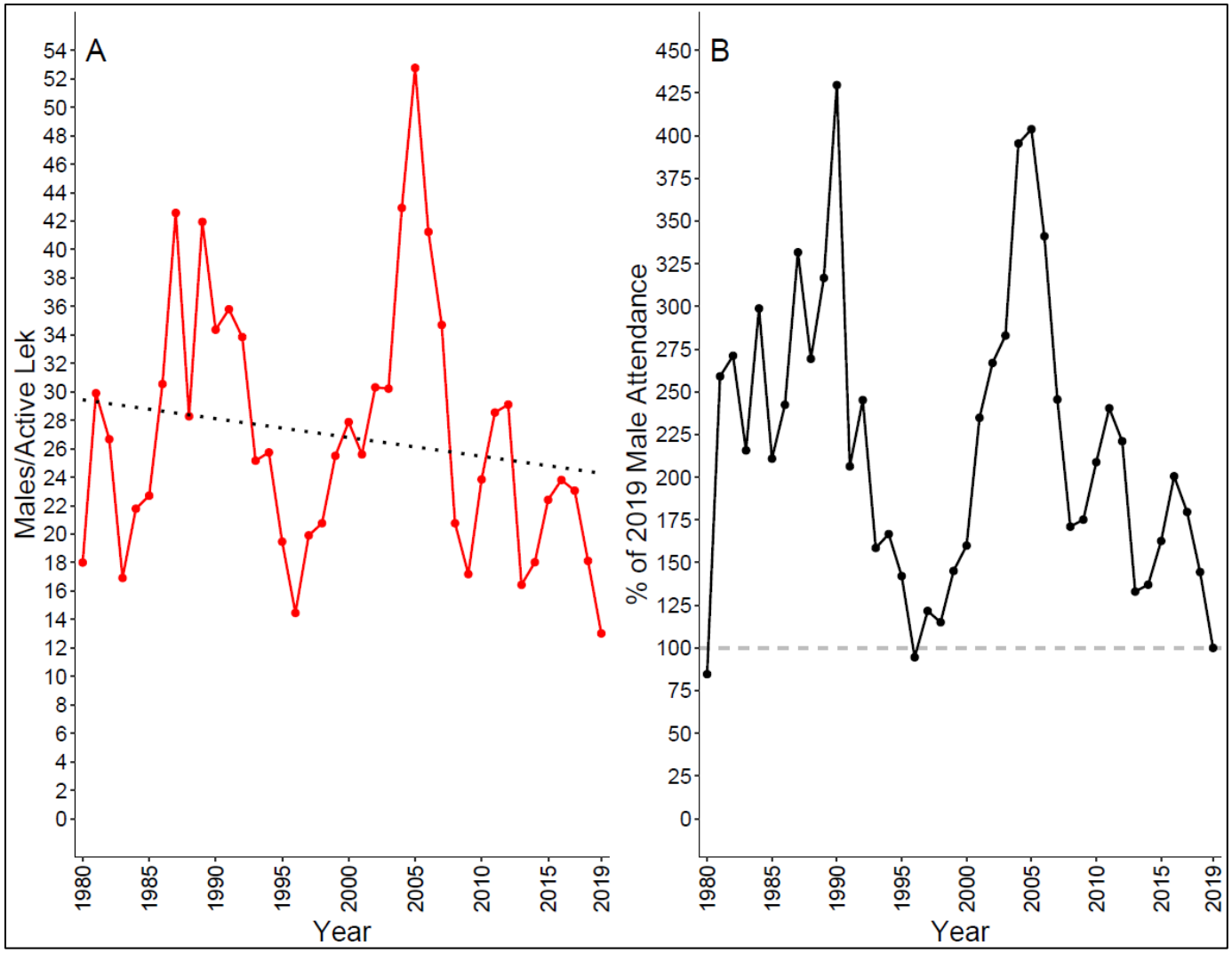

Figure 9. Greater sage-grouse population trend in the **Lakeview BLM District**, 1980 – 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

Prineville District

Survey effort in the Prineville District during 2019 was similar to levels expended annually since 2016 (Table 6; Figure 10). During 2019, 233 ground surveys were conducted at 82 leks comprising 37 complexes. This constitutes 64.6% of the 127 leks, and 58.7% of the 63 complexes, known to exist or have existed in the District. Survey effort per lek decreased slightly from 2018 levels, with each lek receiving on average 2.84 surveys during the monitoring season. No previously unknown leks were discovered in the district, however 1 complex was split into 2 complexes in order to better conform to the definitions of the Conservation Assessment and Strategy.

The estimated spring sage-grouse population in the Prineville District was 1,404 individuals (95% CI: 1,377 – 1,430 individuals), a -19.2% decline from 1,738 individuals in 2018. During 2019, observed male attendance at complexes also counted during 2018 declined -18.5% from 493 to 402 observed males. The 5-year average population trend in the district has been slightly negative at -2.86%. Observed male attendance is 30.3% below the 2003 baseline level (n_{2003} = 488, n_{2019} = 340), at complexes observed during both 2003 and 2019 (Figure 11). Data collected since the 2011 Conservation Assessment suggest a small, non-significant reduction in average lek complex size since 1980, with average males per lek complex declining by -0.06 males per year over this period (Multiple R^2 = 0.06, p-value = 0.11; Figure 11). However, it appears that this relationship is primarily driven by 2 years of high observed lek attendance during the early 1980s, when the number of leks counted was low.

Vale District

Survey effort in the Vale District (excluding the Baker Resource Area) during 2019 represented the greatest survey effort achieved in the district (Table 7; Figure 12). During 2019, 650 ground surveys were conducted at 286 leks comprising 191 complexes. This constitutes 64.3% of the 445, and 58.6% of the 326 complexes, known to exist or have existed in the District. Survey effort increased from 2018 levels, with each lek receiving on average 2.27 surveys during the monitoring season. One previously unknown lek was discovered by ground observers in the district in 2019.

The estimated spring sage-grouse population in the Vale District was 5,906 individuals (95% CI; 5,623 – 6,189 individuals), a -17.1% decline from 7,126 individuals in 2018. This was the second consecutive year of population decline in the district. During 2019 observed male attendance at complexes also counted during 2018 decreased -16.3% from 1,567 to 1,312 individuals. Five-year average population trend in the District was 2.8% between 2014 and 2019. However observed male attendance remains -49.7% below the 2003 baseline level (n_{2003} = 473, n_{2019} = 238), at complexes counted during both 2003 and 2019 (Figure 13). Data collected since the 2011 conservation assessment a stable trend in average complex size since 1993 (Multiple R^2 = 0.003, p-value = 0.80; Figure 13).

Table 6. **Prineville BLM District** greater sage-grouse lek complex ground survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1980 – 2019.

	1980-84		1985-89		1990-94		1995-99		2000-04		2005-09		2010-14		2015-18		2019	
Variable	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*
Known Complexes	16.60	*0.40*	25.60	*3.28*	36.40	*0.75*	42.20	*0.20*	55.20	*0.80*	56.60	*0.24*	59.00	*1.00*	63.00	*0.00*	63.00	-
Complexes Counted	11.00	*2.02*	17.40	*5.10*	25.80	*2.42*	38.40	*0.87*	52.20	*0.97*	48.00	*3.78*	39.80	*1.46*	37.25	*0.87*	37.00	-
Proportion Complexes Counted	0.67	*0.13*	0.63	*0.12*	0.71	*0.05*	0.91	*0.02*	0.95	*0.01*	0.85	*0.07*	0.67	*0.02*	0.59	*0.01*	0.59	-
Active Complexes	6.80	*1.39*	15.20	*4.91*	21.40	*1.69*	32.80	*0.86*	37.20	*0.73*	31.20	*2.48*	30.20	*0.92*	29.25	*2.47*	32.00	-
Males Per Complex	10.22	*1.67*	13.26	*0.83*	13.32	*0.83*	12.50	*0.19*	10.56	*0.34*	9.95	*1.12*	11.36	*0.53*	12.14	*0.64*	10.95	-
Males Per Active Complex	16.72	*2.53*	15.77	*0.73*	15.92	*0.67*	14.65	*0.38*	14.82	*0.51*	15.35	*1.82*	14.91	*0.41*	15.55	*0.54*	12.66	-
Proportion Change - Male Attendance	-0.24	*0.13*	0.11	*0.17*	-0.02	*0.09*	-0.04	*0.02*	-0.04	*0.04*	-0.07	*0.09*	0.10	*0.13*	0.01	*0.02*	-0.18	-

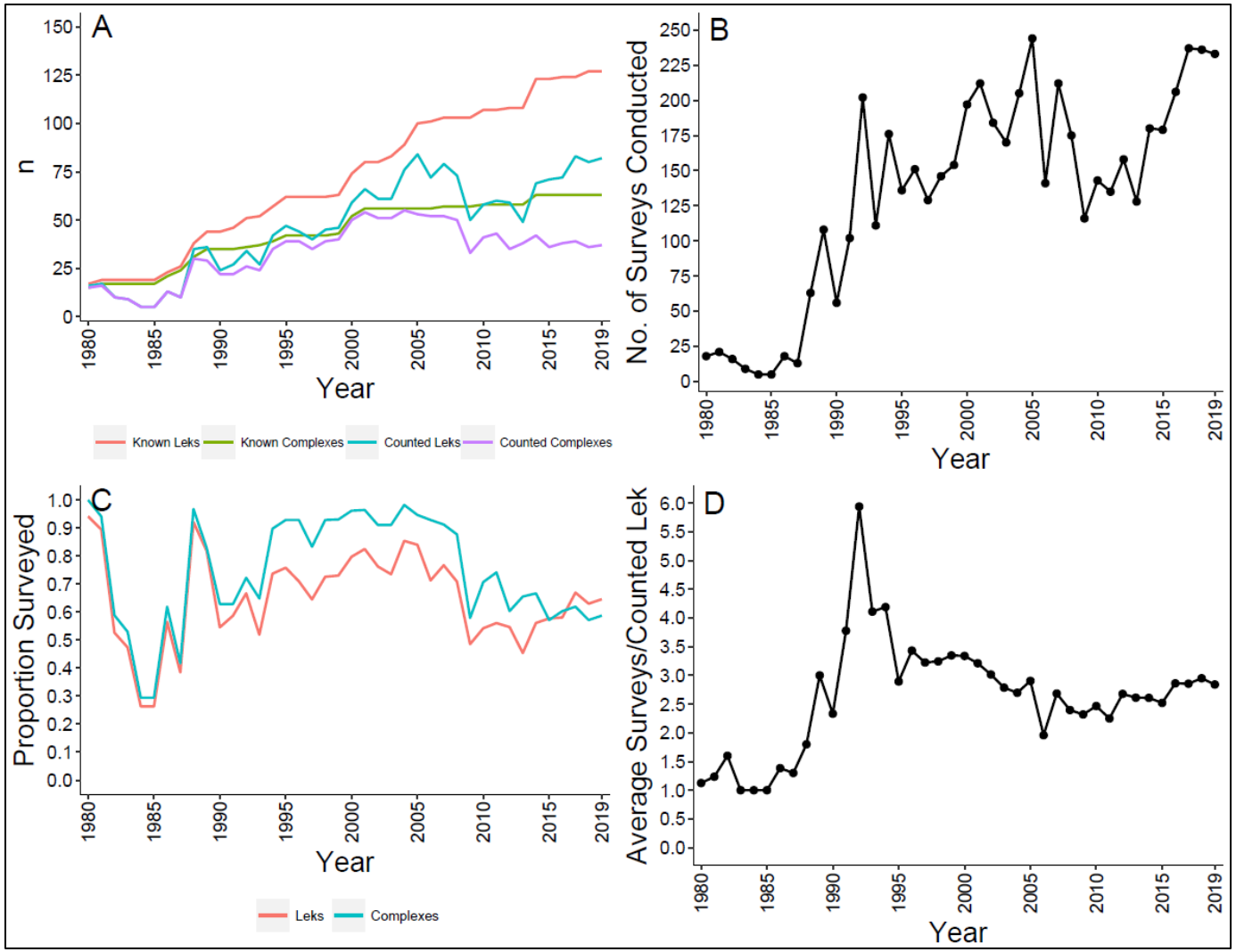

Figure 10. **Prineville BLM District** greater sage-grouse survey effort statistics, 1980 – 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

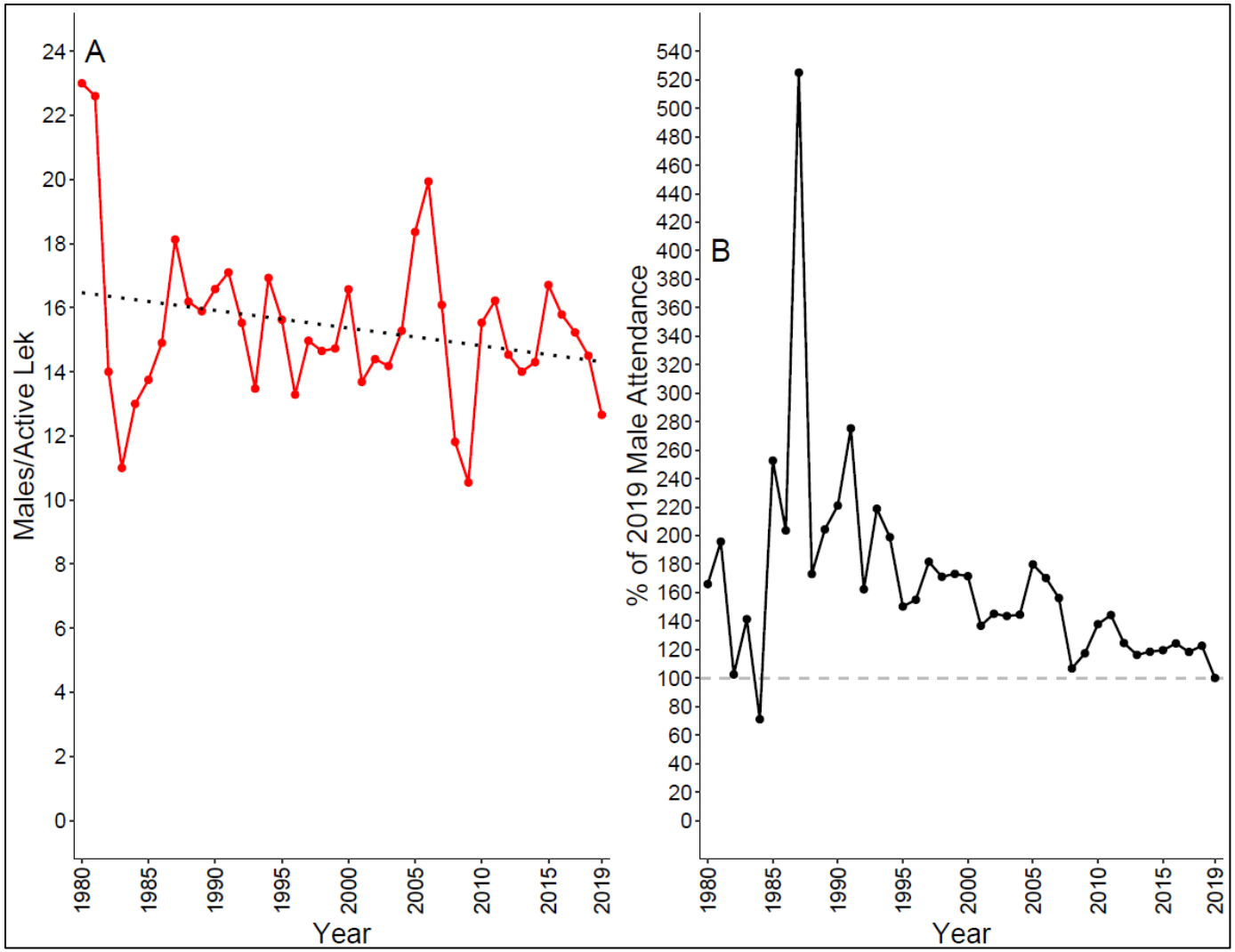

Figure 11. Greater sage-grouse population trend in the **Prineville BLM District**, 1980 – 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

Table 7. **Vale BLM District** (Excluding the Baker Resource Area) greater sage-grouse lek complex ground survey effort, and trend in maximum male lek complex attendance summarized over 5-year periods, 1993 – 2019.

	1993-94		1995-99		2000-04		2005-09		2010-14		2015-18		2019	
Variable	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*	Mean	*SE*
Known Complexes	110.50	*18.50*	206.40	*15.65*	250.60	*0.24*	284.00	*3.16*	297.80	*2.71*	320.50	*3.70*	326.00	-
Complexes Counted	39.00	*19.00*	59.80	*7.73*	21.60	*1.29*	81.60	*8.94*	110.60	*21.24*	199.00	*12.99*	191.00	-
Proportion Complexes Counted	0.33	*0.12*	0.30	*0.05*	0.09	*0.01*	0.29	*0.03*	0.37	*0.07*	0.62	*0.04*	0.59	-
Active Complexes	36.50	*16.50*	46.80	*4.45*	19.00	*0.55*	58.40	*4.86*	59.80	*8.75*	94.75	*3.21*	98.00	-
Males Per Complex	17.61	*6.19*	10.45	*0.64*	21.30	*2.12*	13.13	*1.89*	11.05	*2.00*	9.12	*0.64*	7.78	-
Males Per Active Complex	18.15	*5.65*	13.14	*0.65*	23.94	*1.97*	17.87	*2.11*	18.84	*2.31*	18.40	*0.78*	15.16	-
Proportion Change - Male Attendance	0.51	*0.83*	-0.06	*0.08*	0.11	*0.05*	-0.05	*0.12*	0.00	*0.11*	0.14	*0.10*	-0.16	-

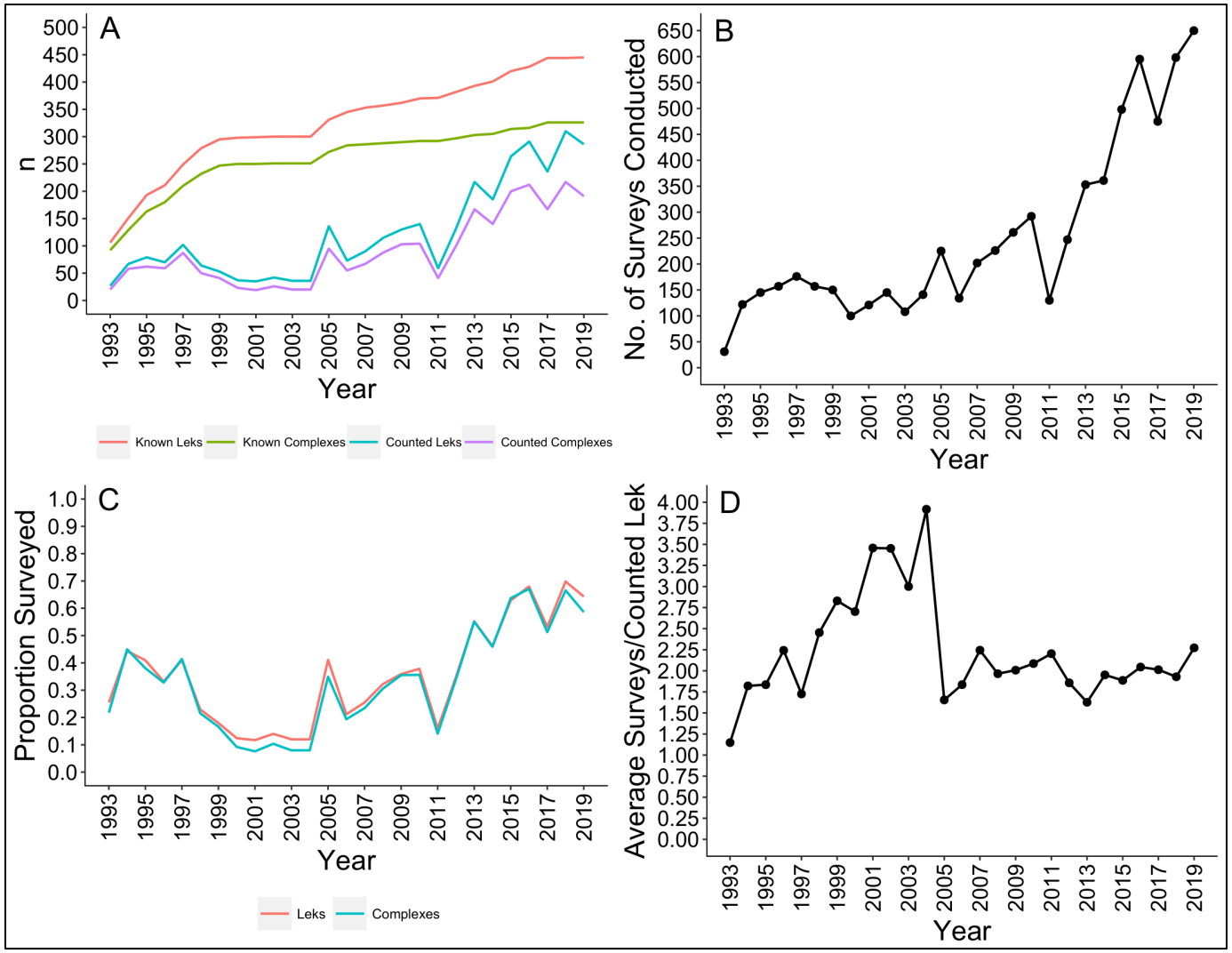

Figure 12. **Vale BLM District** (excluding the Baker Resource Area) greater sage-grouse survey effort statistics, 1993 – 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

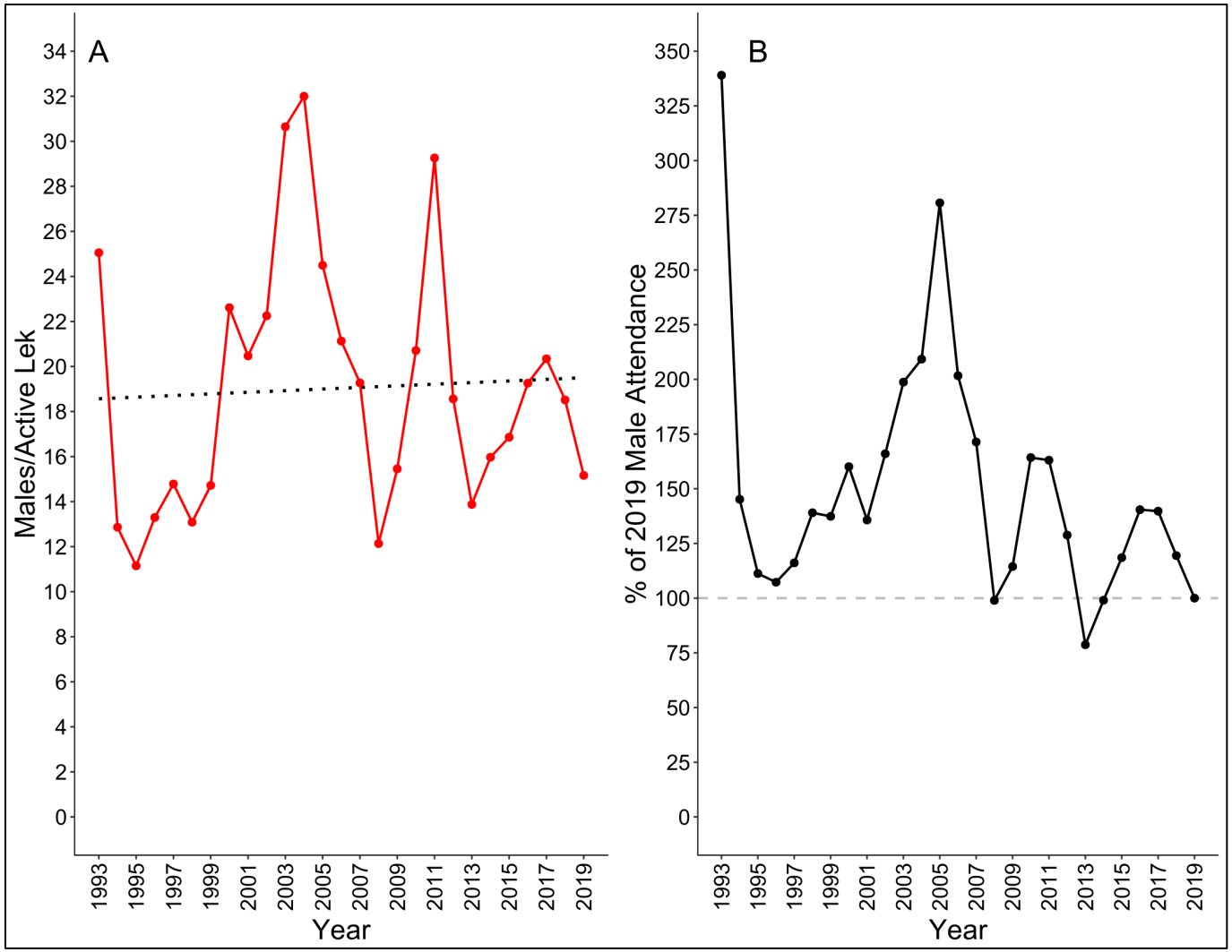

Figure 13. Greater sage-grouse population trend in the **Vale BLM District** (excluding the Baker Resource Area), 1993 – 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

Summary and Conclusions

The sage-grouse population in Oregon experienced a third consecutive year of population decline in 2019, decreasing by -24.9% from 2018, to an estimated 13,827 individuals. Declines occurred in the Burns, Lakeview, Prineville, and Vale BLM Districts, ranging from -17.1% to -35.4%. Analysis suggested populations increased by 26.1% in the Baker BLM Resource area, however this increase appears to be spurious and due to artifacts of the analysis procedure. Population trends at the statewide level are primarily driven by the Burns, Lakeview, and Vale Districts, which contain approximately 90% of the statewide population. Typically, further variation in population trend exists within the state at the scale of individual PACs, however in 2019 population declines were observed in 17 of 19 PACs where sufficient data was collected to analyze trends (Appendix I).

Sage-grouse populations exhibit density dependent fluctuations over time (Garton et al. 2011), however analysis in 2019 suggests that the population has declined to the lowest level observed in the 1980 – 2019 analysis period, and is currently more than 50% below the 2003 statewide baseline population of approximately 29,000 individuals. Several factors contributed to greater uncertainty in the 2019 population estimate than in previous years. Recent research in Wyoming suggests that attendance of males on leks may be more variable than previously suspected, and can be negatively affected by precipitation (Fremgen et al. 2019). Anecdotal observations suggested that the onset of lekking was delayed by approximately 2 weeks in 2019, and during the first half of April rainy weather was common across southeastern Oregon. These factors may have reduced male lek attendance, although no telemetered males existed in Oregon with which to empirically assess attendance rates in 2019. Given the lack of telemetry with which to assess attendance rates, it will not be clear, until lek counts are completed in 2020, to what extent depressed attendance rates may have impacted estimated population trend in 2019. A very large increase in estimated population next year (given optimal survey conditions) would suggest depressed attendance rates played a significant role in the negative trend observed in 2019. Conversely population stability, or a continued population decline would suggest that attendance rates likely weren't depressed in 2019. Initial projections of population trend based on production estimates (chicks/hen) from hunter harvested wings in 2018 (Appendix III), suggested that population trend in 2019 would be stable to slightly declining. The lack of agreement between these early projections and the observed trend in 2019 suggest either that the wing data is becoming less reliable due to low sample size, or provides more support for the hypothesis that attendance was depressed in 2019.

Regardless, some amount of population decline occurred in 2019, depressed attendance rates are unlikely to explain an almost 25% decline in estimated population. While the decline in 2019 tracks the expected population cycle in Oregon, the population estimate this year should be taken as a cause for concern. Continued decline in the population in 2020 would provide more evidence that carrying capacity in Oregon has been reduced (Garton et al. 2011). Continued conservation efforts to improve and restore sage-grouse habitat will positively affect sage-grouse populations over the long-term, allowing larger population peaks, and ameliorating troughs in the population cycle, and may need to be accelerated should populations not stabilize.

Estimating sage-grouse populations from lek counts is a complicated process, containing multiple assumptions (Beck and Braun 1980, Walsh et al. 2004). Standardized count procedures,

in place in Oregon since 1996, have improved the reliability of sage-grouse population estimates; however, multiple potential sources of uncertainty remain. These include assumptions regarding the lek attendance rate of male sage-grouse, knowledge of the distribution of leks in an area, bias in the selection of leks to be monitored in a given year, and uncertainty regarding the rate of new lek formation. Due to these sources of uncertainty all estimates of sage-grouse population size in Oregon should be considered indices only, with the relationship between these indices and the true population size remaining unknown (Walsh et al. 2004, ODFW 2011).

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Appendix I – PAC Scale Survey Effort and Population Trend

ODFW delineated the breeding habitat, based on lek size and distribution, of approximately 90% of the state's sage-grouse population, and grouped this area into 20 "Sage-Grouse Core Areas" during 2011 – 2012 (ODFW 2011; Figure A1.1). Since the initial delineation of these core areas, they have been incorporated into multiple assessments and regulatory documents, including the 2015 USFWS "Not-Warranted" decision (USFWS 2015), the BLM Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment (ARMPA; BLM 2015), and the Oregon Sage-Grouse Action Plan (SageCon 2015). The term Priority Area of Conservation (PAC) corresponds directly with ODFW's core areas, and the term Priority Habitat Management Area (PHMA) describes the portions of each core area under BLM administration. Annual PAC-scale population assessments are integral to the adaptive management approach outlined in the ARMPA. Concurrent with their adoption in various regulatory documents, information regarding population trends at the scale of individual PACs has received heightened attention; the PAC has become the de facto scale of interest for much of the landscape-scale sage-grouse habitat assessment and conservation currently ongoing as part of sage-grouse management plan implementation. As such, it is appropriate to report sage-grouse survey effort and population trend information at the PAC scale. Presented below is information at the scale of individual PACs regarding survey effort during the 1980 – 2019 period, as well as population trend information reported in terms of males per active lek, and proportional change in male lek attendance following the methodology used in the main body of this document (Table A1.1 – Table A1.2; Figures A1.2 – A1.43). The information presented below was derived from the same base data used to make ARMPA "trigger" determinations, however it has been analyzed using different methods than those used to make ARMPA trigger decisions. As such, no effort is made to pre-project BLM trigger decisions, and all information presented below should be used for informational purposes only.

As described in the main body of this report, change in lek size over time is depicted using the average number of males counted per active lek in a given PAC. This metric may be misleading for some of the PACs presented below. In many PACs, few leks were counted in the early portion of the periods analyzed and often the leks that were counted were large. As knowledge of lek distribution within PACs, and across the state, has increased, many relatively small leks have been identified and surveys of those leks have increased in recent years. The recent routine counting of these smaller leks has likely corrected bias in the males/active lek metric, reducing the average size of counted leks, and thus potentially indicating an artificial decline in lek size in some areas.

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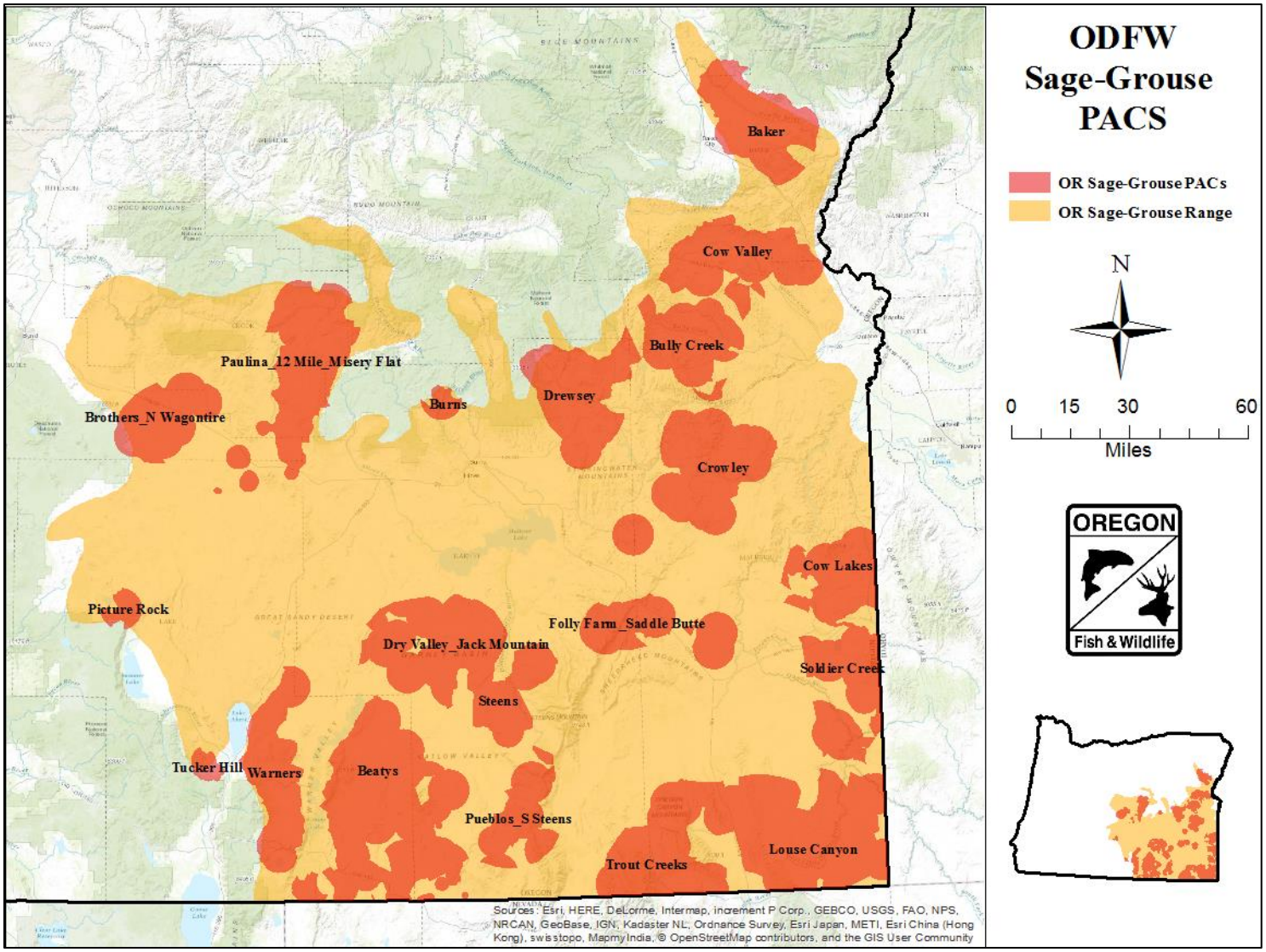


Figure A1.1. Oregon greater sage-grouse Priority Areas for Conservation (PACs).

Table A1.1. Survey effort statistics for the 20 Oregon greater sage-grouse PACs, and leks outside of PACs, 2019.

PAC	Total Known Leks	Total Known Complexes	Counts Conducted			Surveyed Sites		% Sites Surveyed		Surveys/Lek	Previously Unknown Sites Located	
			Total	Ground	Aerial	Leks	Complexes	Leks	Complexes		Leks	Complexes
Baker	65	45	153	153	0	50	33	76.9	73.3	3.06	0	0
Beatys	155	86	162	162	0	77	47	49.7	54.6	2.10	0	0
Brothers/N. Wagontire	45	18	101	101	0	33	11	73.3	61.1	3.06	0	0
Bully Creek	41	28	88	88	0	39	26	95.1	92.9	2.26	0	0
Burns	3	2	1	1	0	1	1	33.3	50.0	1.00	0	0
Cow Lakes	54	36	102	102	0	40	22	74.1	61.1	2.55	0	0
Cow Valley	56	44	35	35	0	16	10	28.6	22.7	2.19	0	0
Crowley	50	33	83	83	0	37	24	74.0	72.7	2.24	0	0
Drewsey	44	22	64	64	0	33	17	75.0	77.3	1.94	0	0
Dry Valley/Jack Mountain	26	18	41	41	0	19	12	73.1	66.7	2.16	0	0
Folly Farm/Saddle Butte	20	15	36	36	0	18	14	90.0	93.3	2.00	0	0
Louse Canyon	60	51	50	50	0	28	23	46.7	45.1	1.79	0	0
Paulina/12-Mile/Misery Flat	60	33	117	117	0	44	33	73.3	69.7	2.67	0	0
Picture Rock	7	4	21	21	0	7	4	100.0	100.0	3.00	0	0
Pueblos/S. Steens	30	19	48	48	0	23	13	76.7	68.4	2.09	0	0
Soldier Creek	47	32	94	94	0	39	24	83.0	75.0	2.41	1	0
Steens	15	10	39	39	0	14	9	93.3	90.0	2.79	0	0
Trout Creeks	96	55	159	159	0	61	34	63.5	61.8	2.61	0	0
Tucker Hill	6	4	14	14	0	5	3	83.3	75.0	2.80	1	0
Warner	57	42	95	92	3	39	29	68.4	69.0	2.44	0	0
Non-PAC	237	193	229	228	1	128	106	54.0	54.9	1.79	1	0

Table A1.2. Population trend data for the 20 Oregon greater sage-grouse PACs, and leks outside of PACs, 2019.

PAC	Observed Males - Common Leks		% Change Male Attendance 2018 to 2019	2014 to 2019 - Average Annual Change in Male Lek Attendance	Observed Males - Common Leks		% Change Male Attendance 2003 to 2019	Lek Size Analysis Period	Annual Change in Lek Size (Males/Year)[a]
	2018	2019			2003	2019			
Baker	92	84	-8.7	-3.3	236	58	-75.4	1996 - 2019	-0.62*
Beatys	373	183	-50.9	-9.7	694	185	-73.3	1980 - 2019	-0.03
Brothers/N. Wagontire	107	89	-16.8	-9.0	79	79	0.0	1980 - 2019	-0.06
Bully Creek	300	239	-20.3	6.5	124	71	-42.7	1996 - 2019	-1.70*
Burns	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cow Lakes	183	148	-19.1	7.8	197	70	-64.5	1993 - 2019	0.10
Cow Valley	96	99	3.1	7.9	64	57	-10.9	1997 - 2019	0.21
Crowley	269	199	-26.0	-3.3	26	11	-57.7	1994 - 2019	0.12
Drewsey	209	109	-47.8	-0.2	82	41	-50.0	1997 - 2019	0.10
Dry Valley/Jack Mountain	52	46	-11.5	-10.4	214	46	-76.5	1982 - 2019	-0.58*
Folly Farm/Saddle Butte	123	98	-20.3	5.5	12	0	-100.0	2005 - 2019	0.12
Louse Canyon	112	93	-17.0	-2.7	NA	NA	NA	2012 - 2019	1.00
Paulina/12-Mile/Misery Flat	411	334	-18.7	4.2	405	279	-31.1	1988 - 2019	0.01
Picture Rock	5	4	-20.0	-26.0	39	4	-89.7	1981 - 2019	-0.30*
Pueblos/S. Steens	119	98	-17.6	-6.6	185	53	-71.4	1996 - 2019	-0.45
Soldier Creek	311	263	-15.4	-2.0	62	29	-53.2	1993 - 2019	0.27
Steens	145	84	-42.1	0.8	181	41	-77.3	1982 - 2019	-1.70*
Trout Creeks	221	184	-16.7	19.1	NA	NA	NA	2012 - 2019	0.11
Tucker Hills	43	51	18.6	14.9	49	37	-24.5	1996 - 2019	-0.21
Warner	169	145	-14.2	3.6	443	189	-57.3	1993 - 2019	-0.18
Non-PAC	346	291	-15.9	-1.3	149	70	-53.0	1980 - 2019	-0.12*

[a]Asterisk indicates significant change in lek size over the analyzed period at alpha value = 0.05.

Baker PAC

The Baker PAC is situated in eastern Baker County, with the north end of the PAC extending into southern Union County, and is completely contained within the Baker BLM Resource Area (Figure A1.1). Sixty-five leks, comprising 45 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1941, and lek counts during the 1940s were incorporated into one of the first scientific studies of sage-grouse in W.M. Batterson and W.B. Morse's "Oregon Sage Grouse", published by the Oregon State Game Commission. Following the work conducted by Batterson and Morse, sage-grouse leks were not surveyed consistently in the Baker PAC until 1996 (Figure A1.2).

Beatys PAC

The Beatys PAC is situated in southeastern Lake County, and southwestern Harney County, and is almost entirely contained within the Lakeview BLM District (Figure A1.1). One hundred fifty-five leks, comprising 86 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1941, with consistent surveys in the PAC beginning in 1980 (Figure A1.4).

Brothers/N. Wagontire PAC

The Brothers/N. Wagontire PAC (often referred to simply as the Brothers PAC) is situated in eastern Deschutes County and southern Crook County, and is almost entirely contained within the Prineville BLM District (Figure A1.1). Forty-five leks, comprising 18 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1948; consistent survey effort has occurred almost continuously in the PAC since leks were first recorded, although knowledge of existing leks increased substantially following dedicated aerial lek searches which occurred in the late 1980s (Figure A1.6).

Bully Creek PAC

The Bully Creek PAC is situated in northeastern Malheur County, and is entirely contained within the Vale BLM District (Figure A1.1). Forty-one leks, comprising 28 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1982. Surveys did not consistently occur at a significant portion of leks within the PAC until 2009, although at least two leks have been surveyed yearly in the PAC since 1994 (Figure A1.8). Population trend information is presented for the Bully Creek PAC from 1994 – 2019 (Figure A1.9), however caution should be employed when interpreting this information due to the low proportion of leks consistently surveyed prior to 2009.

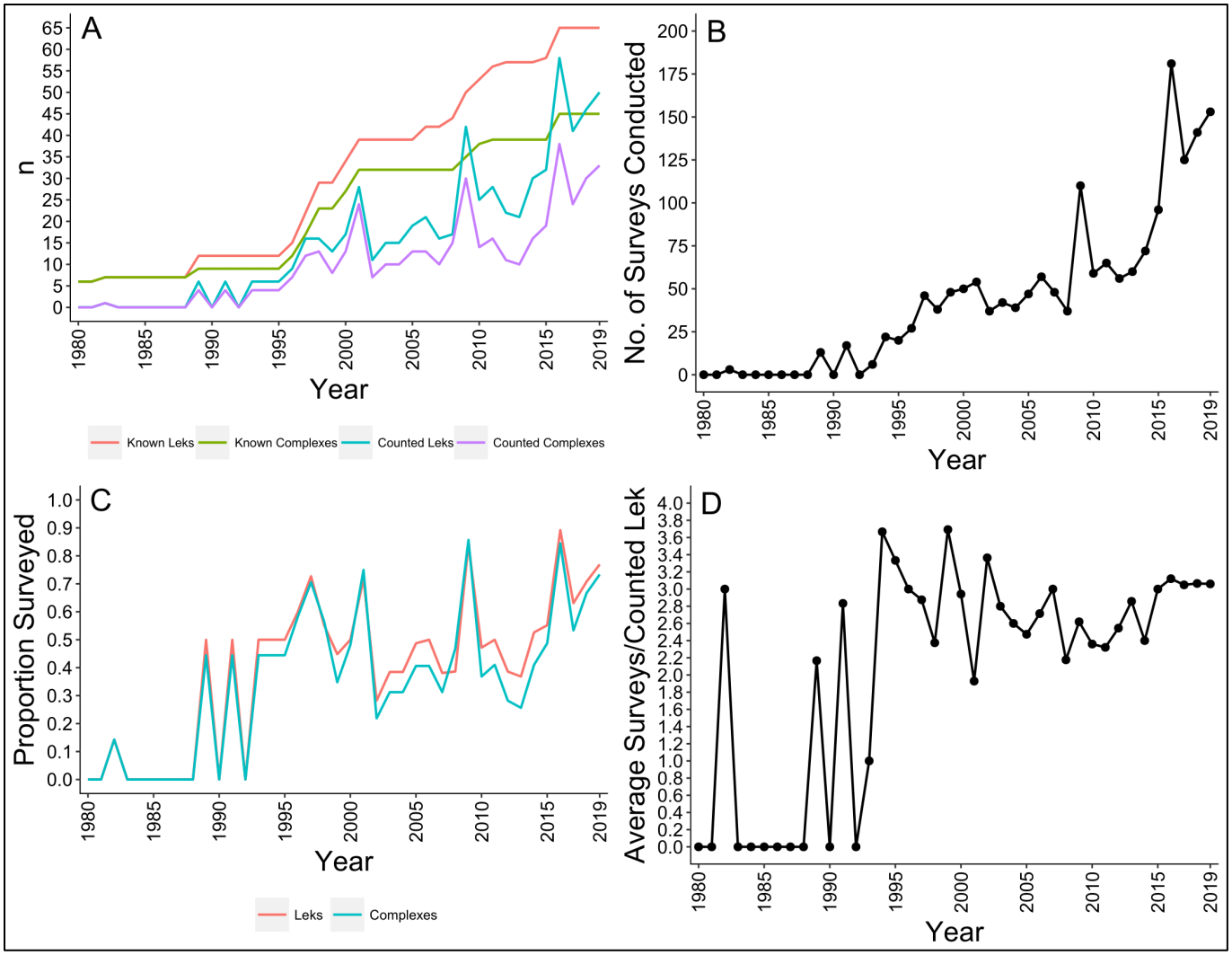


Figure A1.2. **Baker PAC** greater sage-grouse survey effort statistics, 1980 – 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

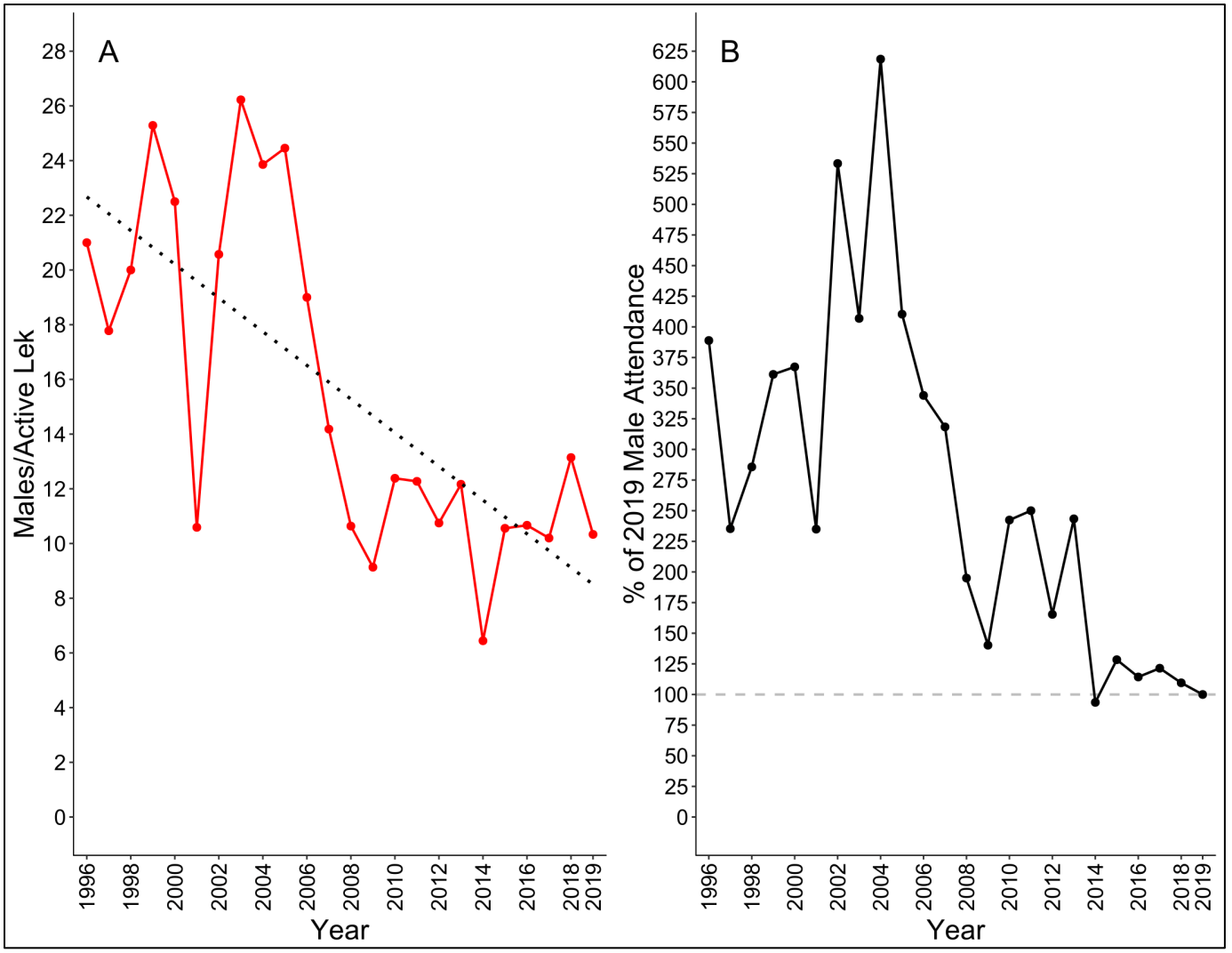


Figure A1.3. Greater sage-grouse population trend in the **Baker PAC**, 1996 – 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

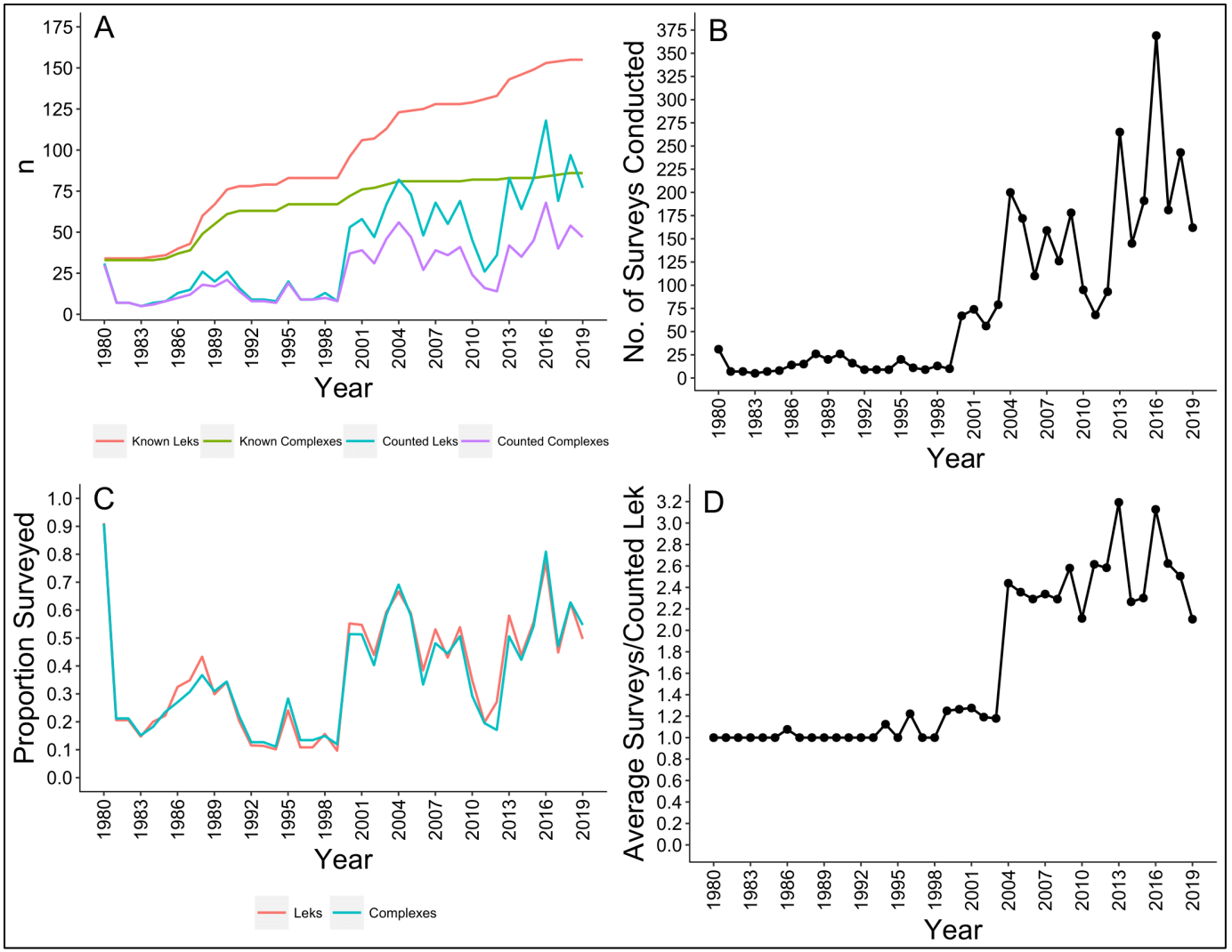


Figure A1.4. **Beatys PAC** greater sage-grouse survey effort statistics, 1980 – 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

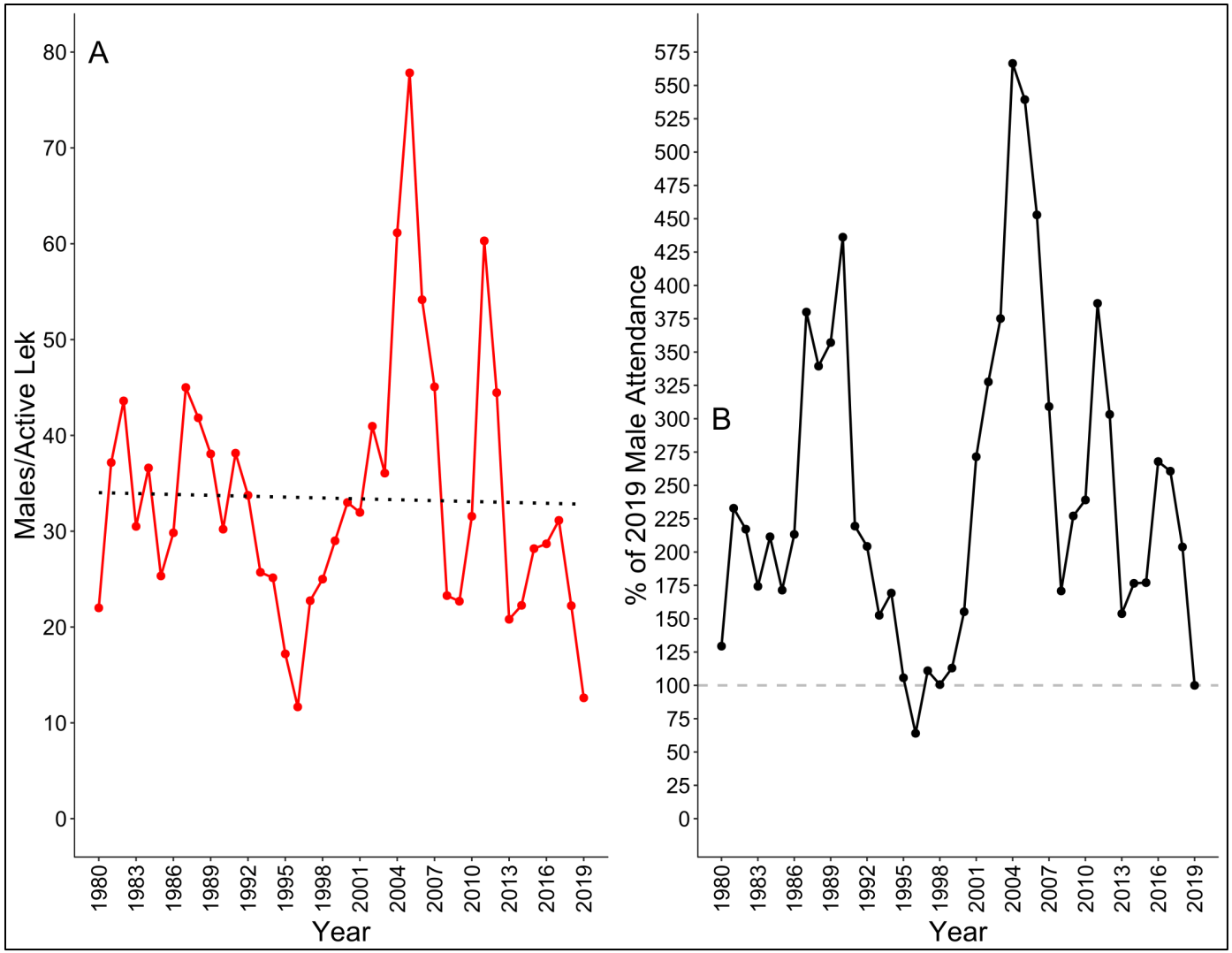


Figure A1.5. Greater sage-grouse population trend in the **Beatys PAC**, 1980 – 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

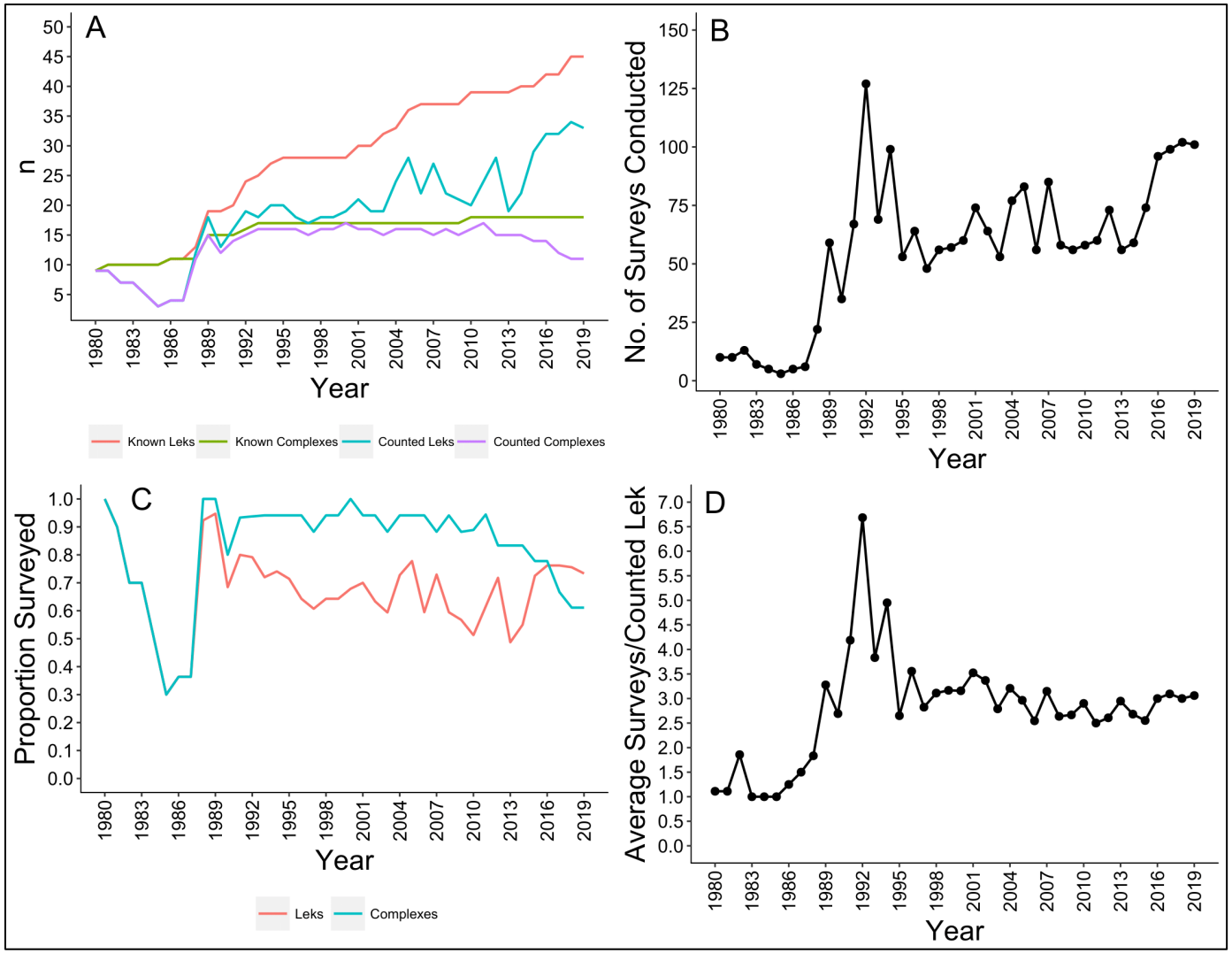


Figure A1.6. **Brothers/N. Wagontire PAC** greater sage-grouse survey effort statistics, 1980 – 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

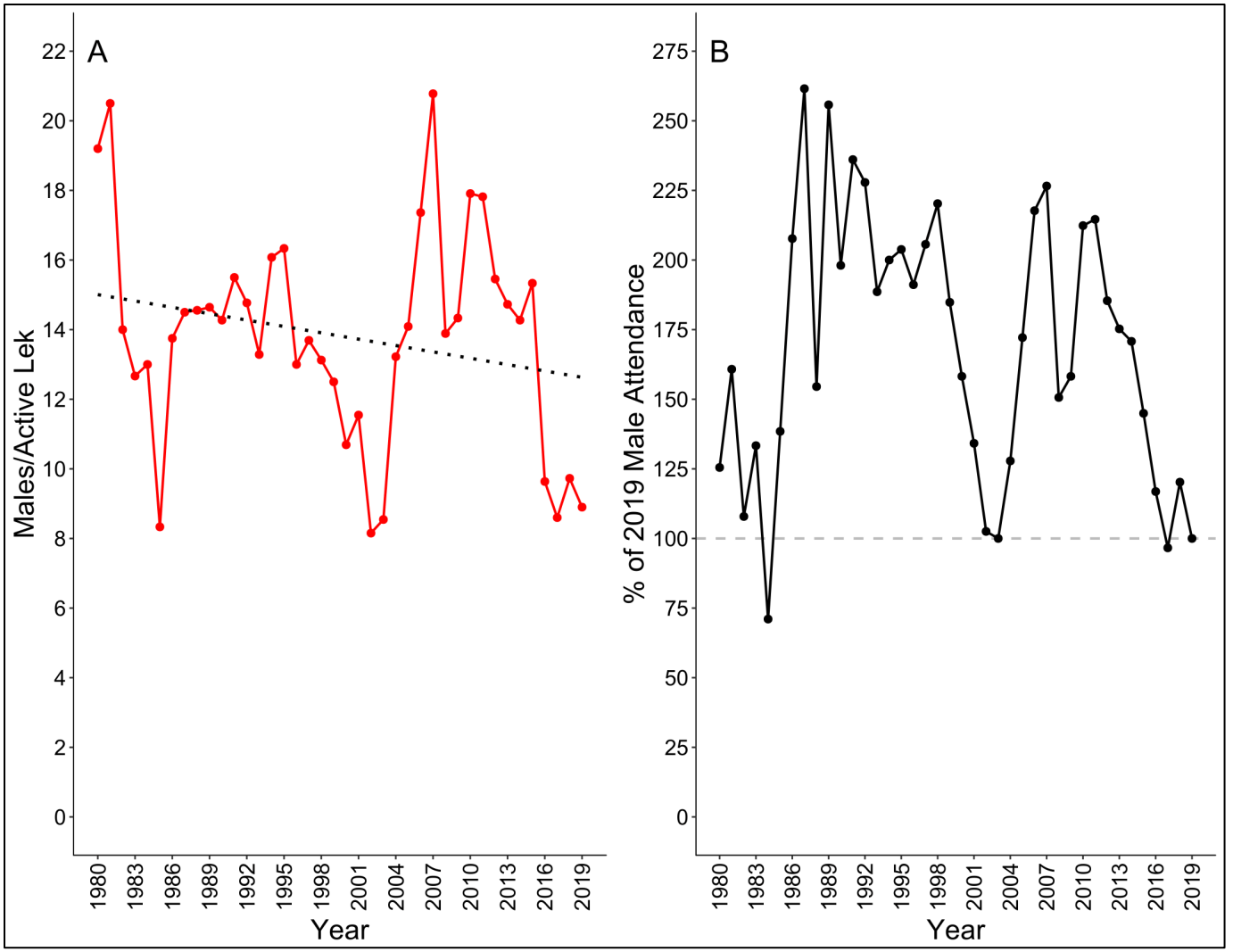


Figure A1.7. Greater sage-grouse population trend in the **Brothers/N. Wagontire PAC**, 1980 – 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

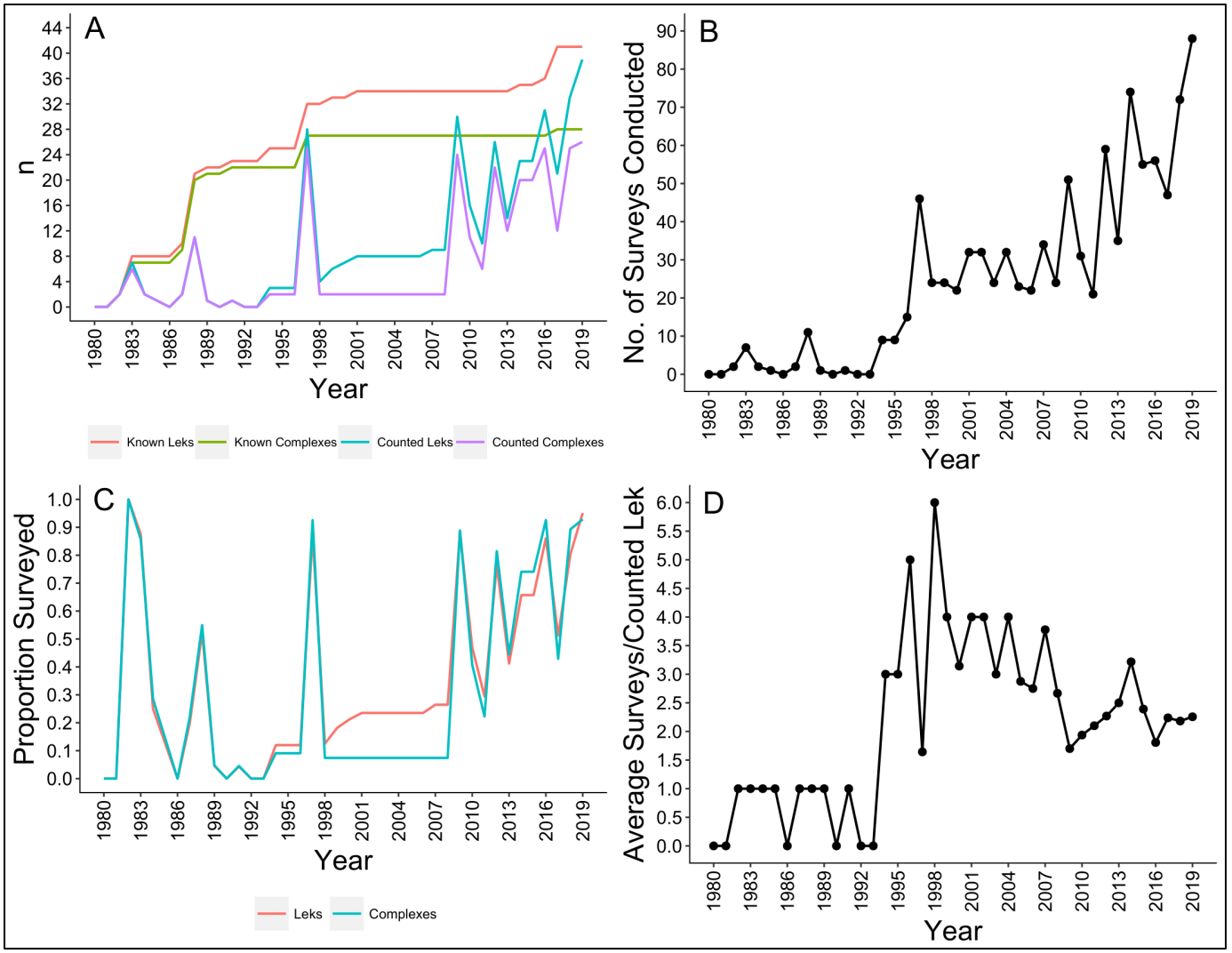


Figure A1.8. **Bully Creek PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

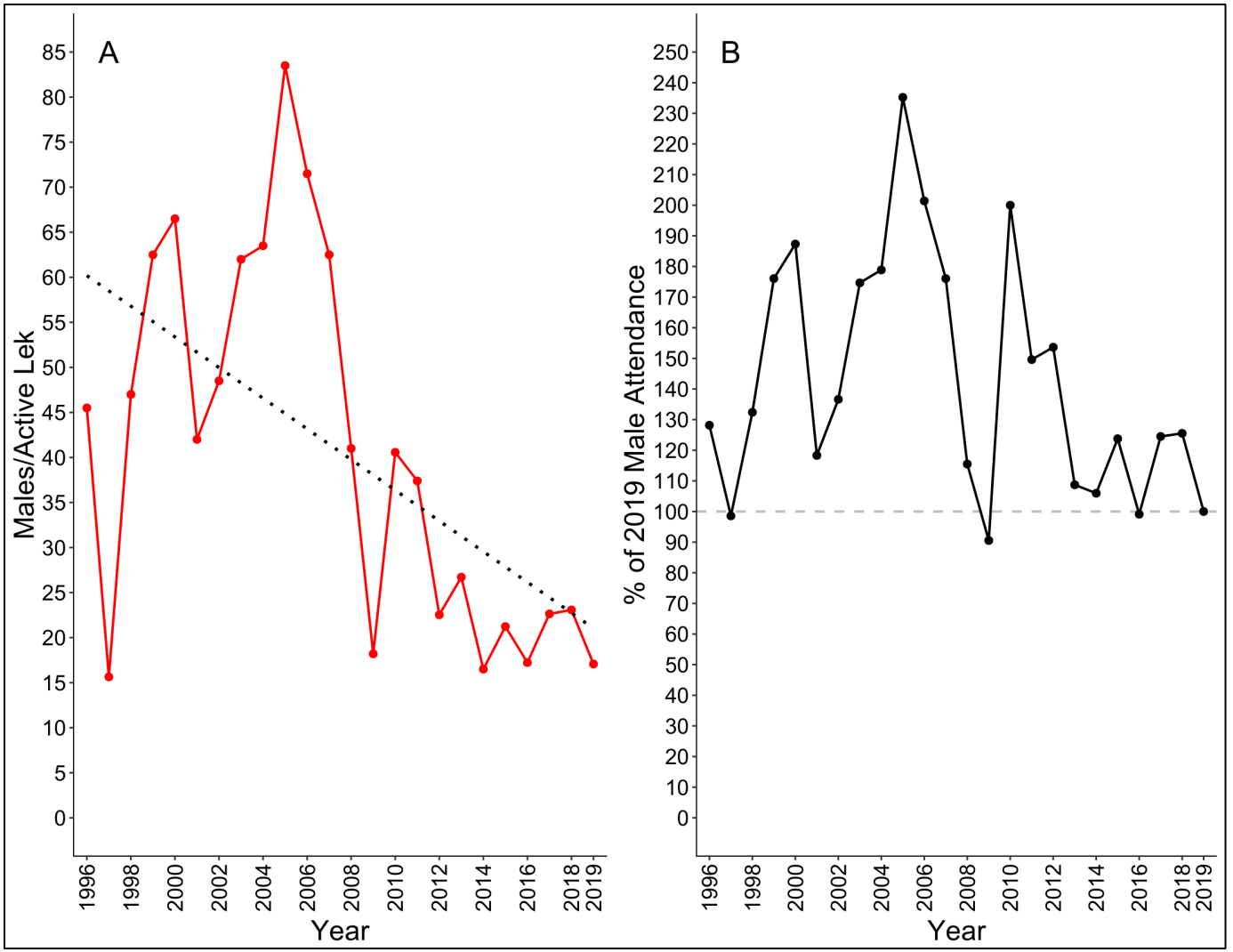


Figure A1.9. Greater sage-grouse population trend in the **Bully Creek PAC**, 1996 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

Burns PAC

The Burns PAC is situated in northern Harney County, and is entirely contained within the Burns BLM District (Figure A1.1). Only three leks, comprising two complexes are known to exist or have existed in the PAC (Table A1.1). During the delineation of core areas in Oregon, generally small polygons such as the Burns PAC were grouped with larger polygons and considered a single core area. However the Burns PAC was not in proximity to any larger core area polygons and thus maintained as a separate PAC. Surveys were first recorded for leks within the PAC in in 1981, however surveys did not consistently occur in the PAC until 2013 (Figure A1.10). During 2019, only one lek was counted in the PAC, which is unoccupied, thus no population trend data is reported for the PAC in 2019.

Cow Lakes PAC

The Cow Lakes PAC is situated in eastern Malheur County, and is entirely contained within the Vale BLM District (Figure A1.1). Fifty-four leks, comprising 36 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1947, however surveys did not consistently occur at a significant portion of leks within the PAC until 1993 (Figure A1.11).

Cow Valley PAC

The Cow Valley PAC is situated in northern Malheur County, and southern Baker County, and is split between the Baker BLM Resource area and the remainder of the Vale District (Figure A1.1). Fifty-six leks, comprising 44 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1941, surveys have been conducted at leks within the PAC annually since 1997, although a significant portion of leks within the PAC were only consistently surveyed beginning in 2015 (Figure A1.13). The majority of the PAC is in private holding, and thus lek survey efforts in the PAC have often been limited by land access issues. Population trend information is presented for the Cow Valley PAC from 1997 - 2019 (Figure A1.14), however caution should be employed when interpreting this information due to the low proportion of leks consistently surveyed prior to 2015.

Crowley PAC

The Crowley PAC is situated in central Malheur County, and is entirely contained within the Vale BLM District (Figure A1.1). Fifty leks, comprising 33 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1984, surveys have been conducted at leks within the PAC annually since 1991, although a significant portion of leks within the PAC were only consistently surveyed beginning in 2006 (Figure A1.15). Population trend information is presented for the Crowley PAC from 1994 - 2019 (Figure A1.16), however caution should be employed when interpreting this information due to the low proportion of leks consistently surveyed prior to 2006.

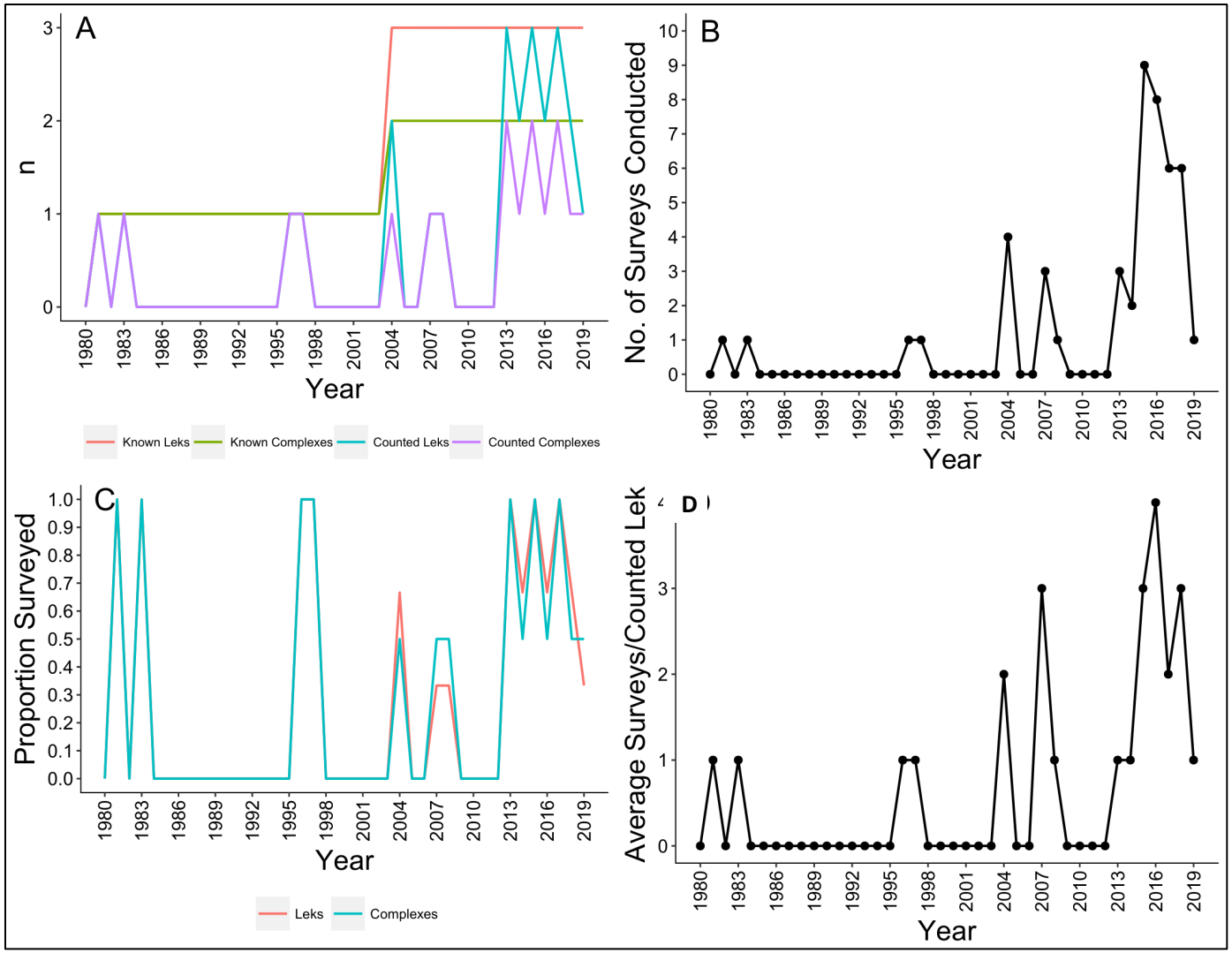


Figure A1.10. **Burns PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

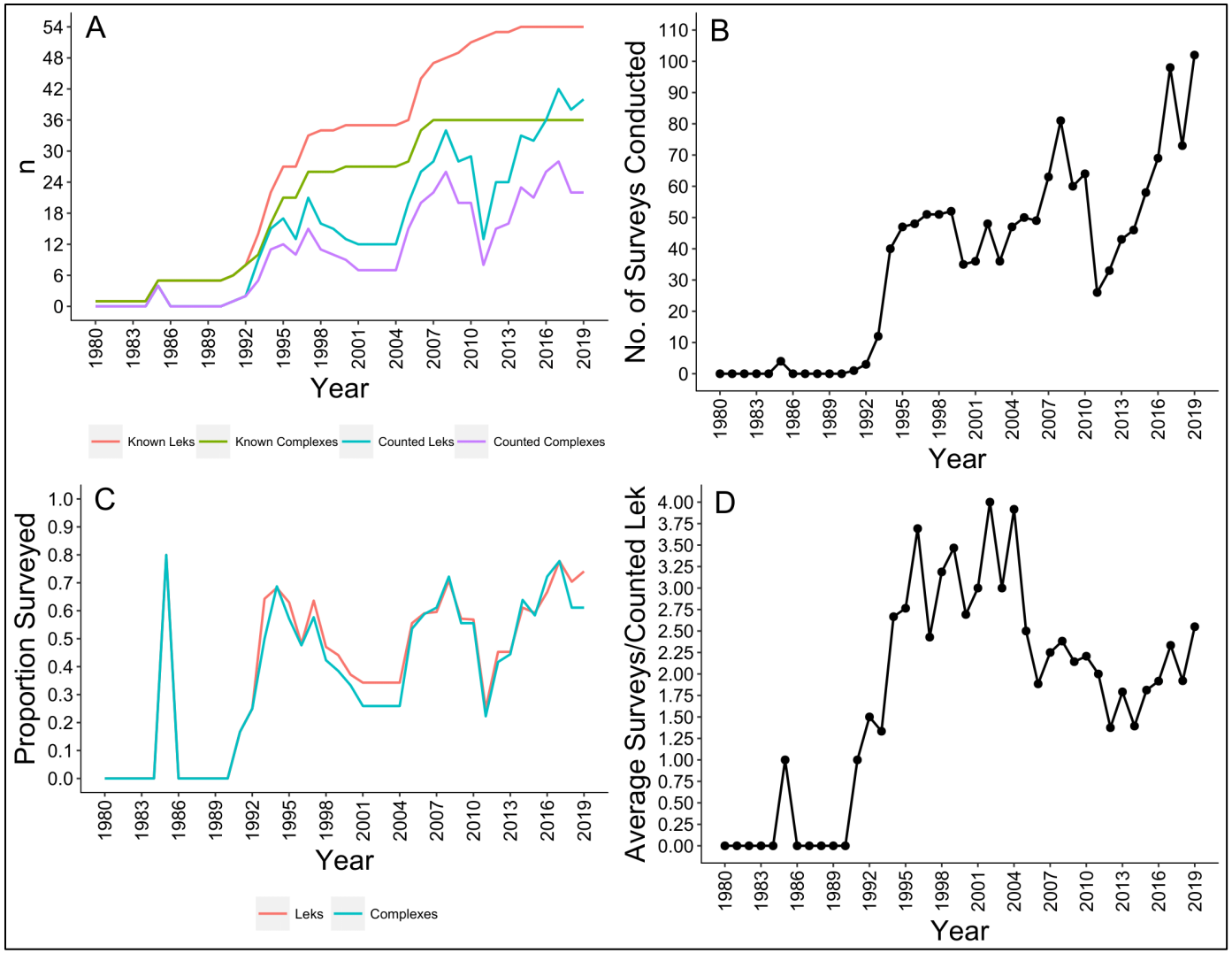


Figure A1.11. **Cow Lakes PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

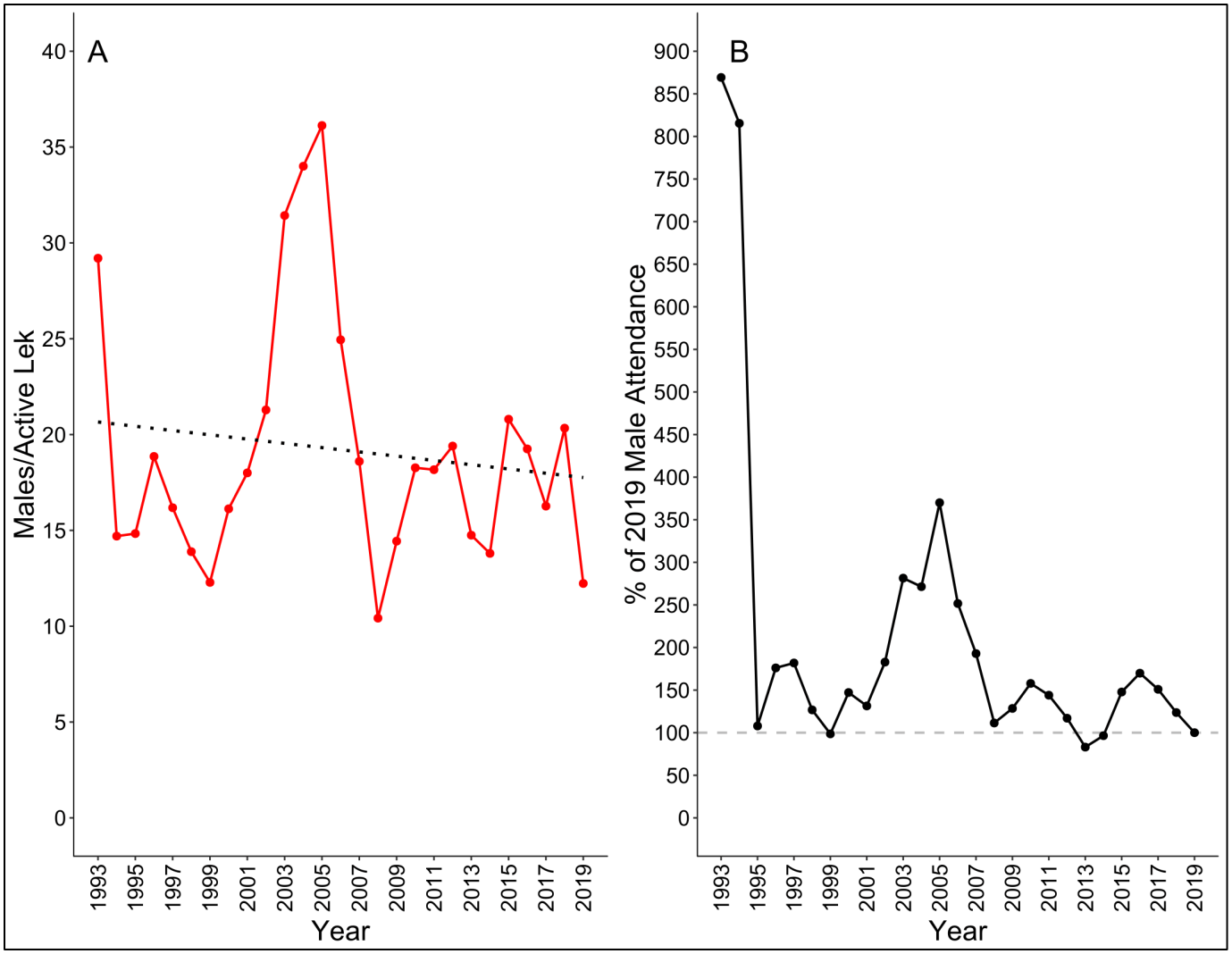


Figure A1.12. Greater sage-grouse population trend in the **Cow Lakes PAC**, 1993 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

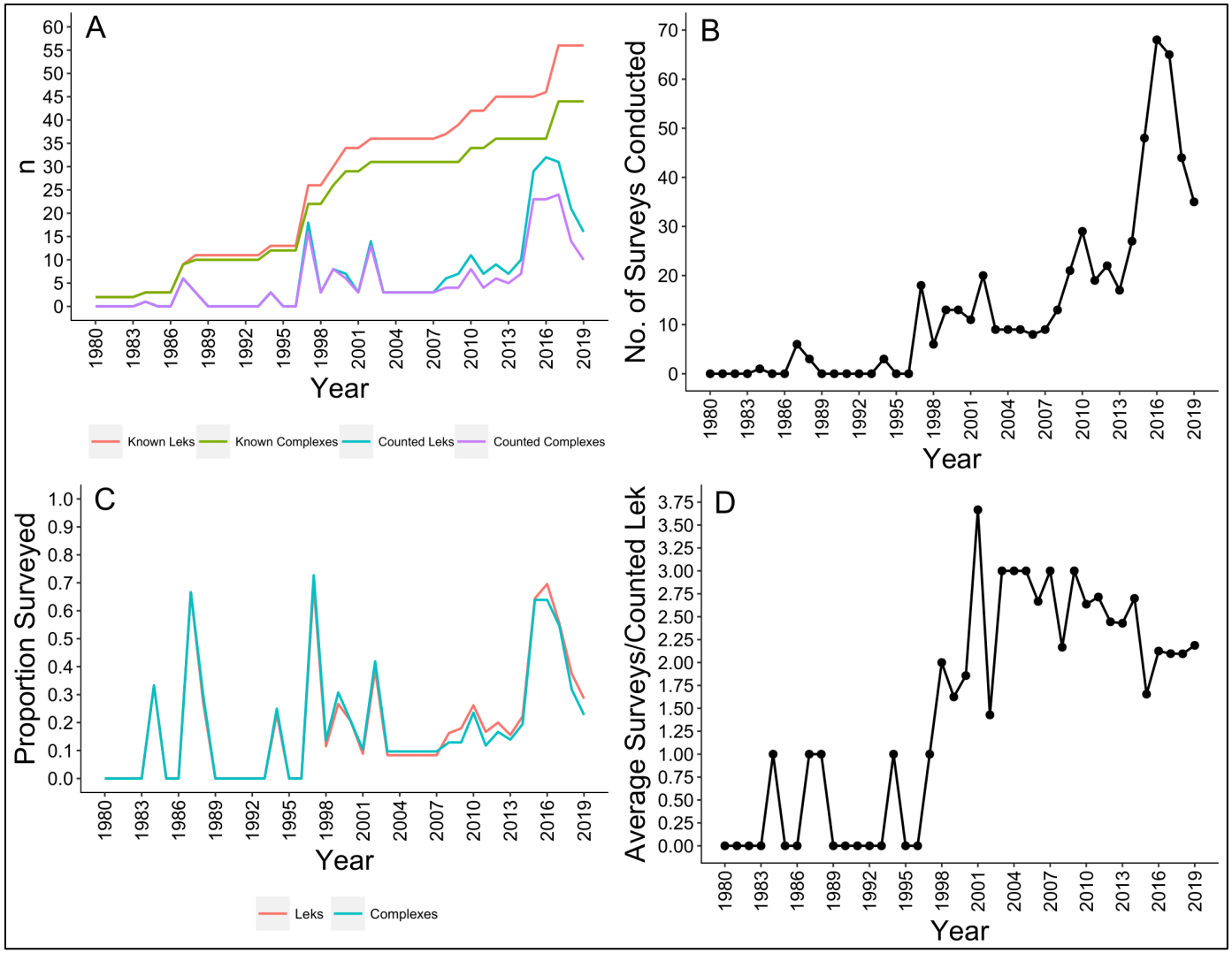


Figure A1.13. **Cow Valley PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

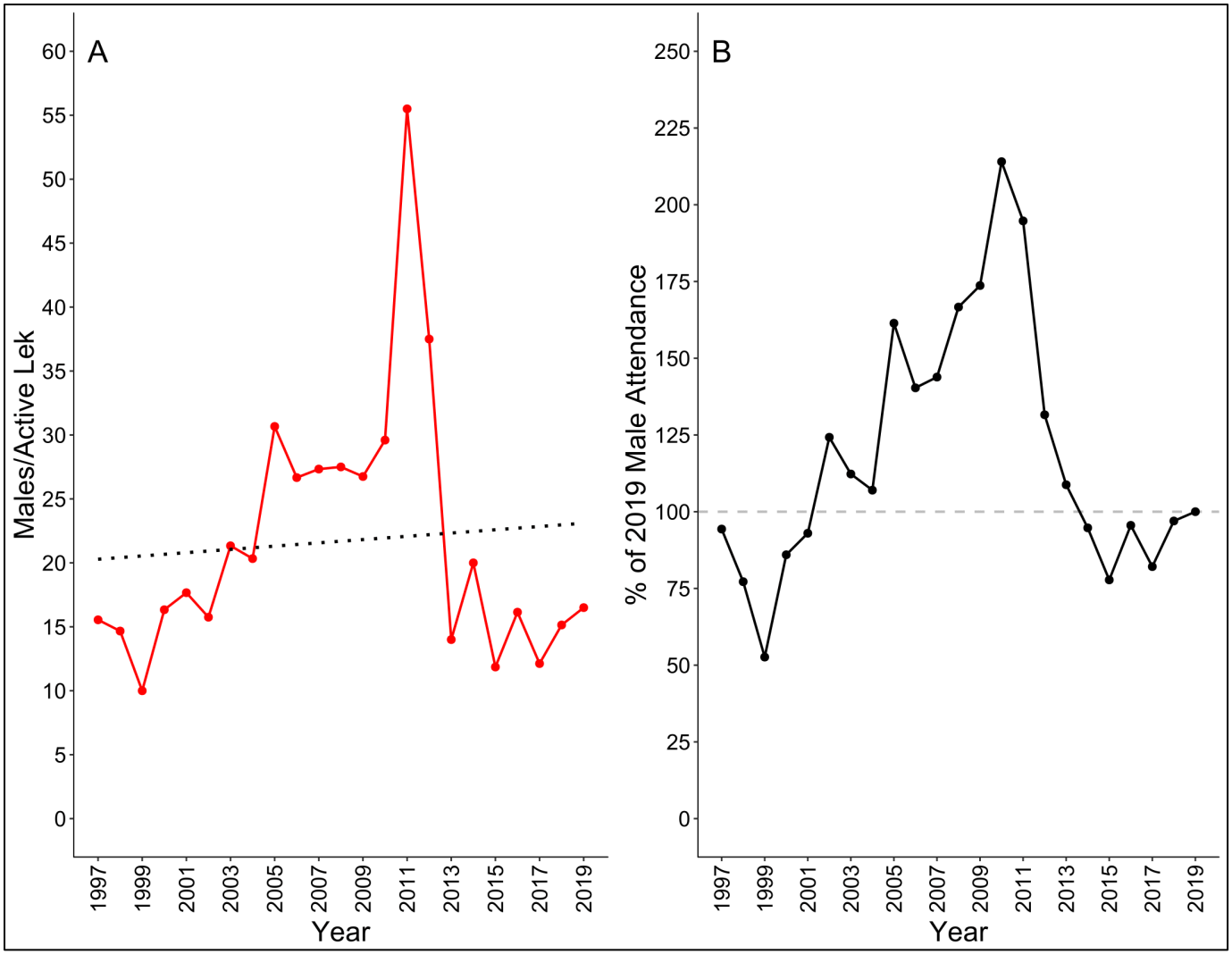


Figure A1.14. Greater sage-grouse population trend in the **Cow Valley PAC**, 1997 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

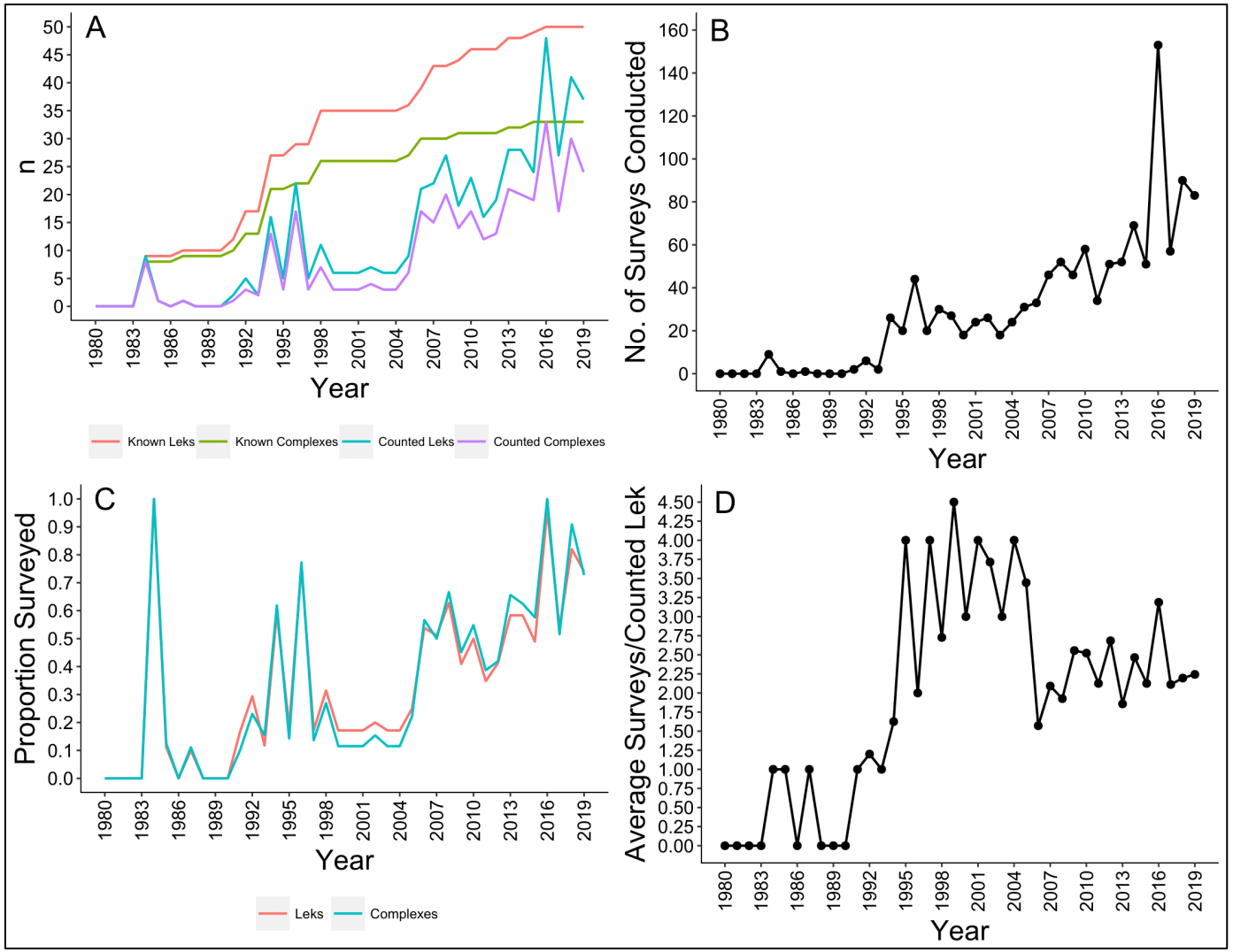


Figure A1.15. **Crowley PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

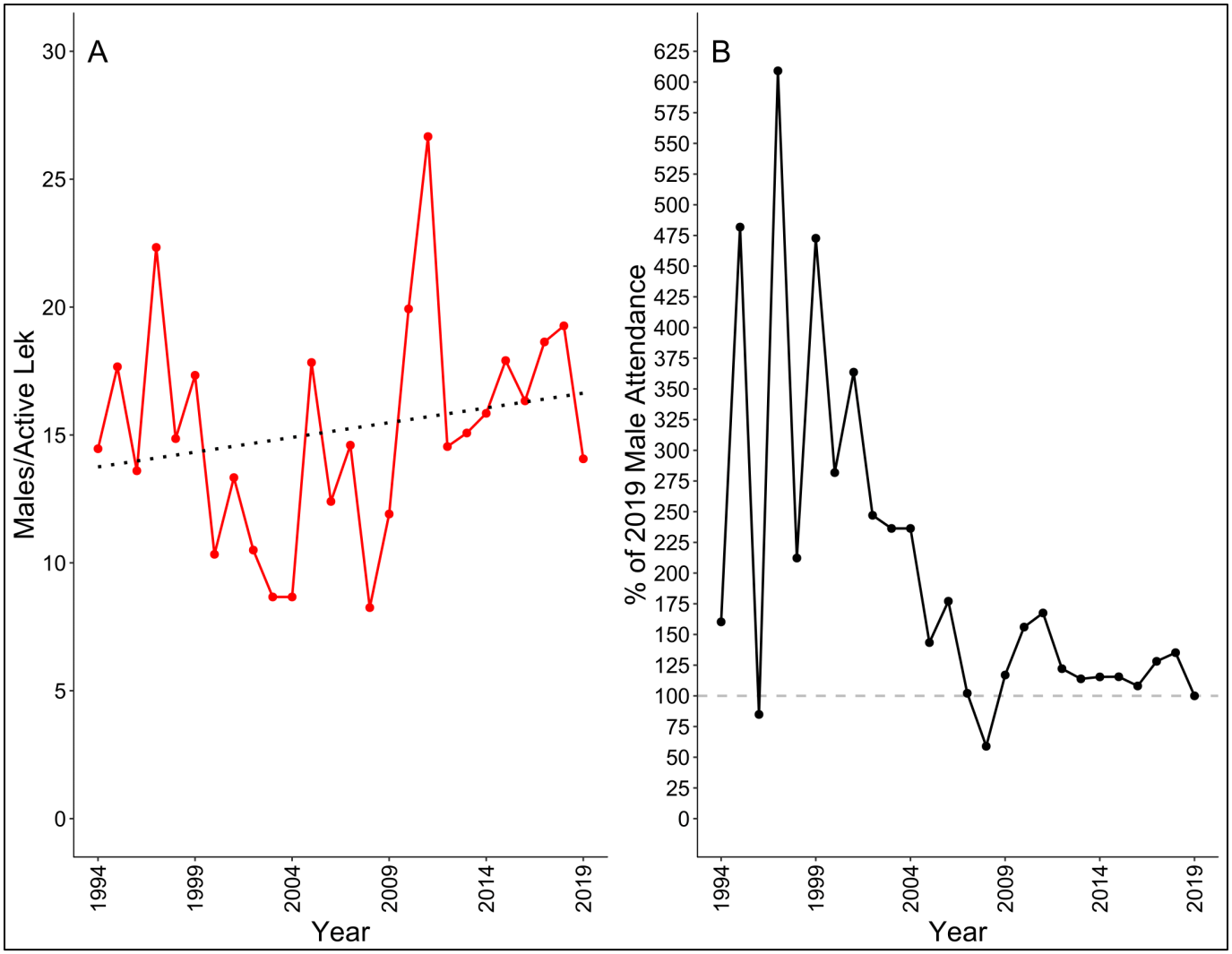


Figure A1.16. Greater sage-grouse population trend in the **Crowley PAC,** 1994 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019

Drewsey PAC

The Drewsey PAC is situated in northwestern Harney County, with a small section extending into northeastern Malheur County, similarly the PAC is primarily contained within the Burns BLM District, although a small section does extend into the Vale BLM District (Figure A1.1). Forty-four leks, comprising 22 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1958, and leks have been surveyed annually in the PAC since 1981 (Figure A1.17). Population trend information is presented for the Drewsey PAC from 1997, when more than two complexes began to be surveyed annually, to 2019 (Figure A1.18), however a significant portion of leks within the PAC were only consistently surveyed beginning in 2009, thus caution should be employed when interpreting population trend information prior to 2009 for this PAC.

Dry Valley/Jack Mountain PAC

The Dry Valley/Jack Mountain PAC (often simply referred to as the Dry Valley PAC) is situated in central Harney County, and is split between the Burns and Lakeview BLM Districts (Figure A1.1). Twenty-six leks, comprising 18 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1970, and a significant portion of known leks within the PAC have been surveyed annually since 1981 (Figure A1.19), although knowledge of lek distribution in the PAC increased substantially following aerial lek searches conducted in 2003. The Dry Valley PAC was heavily impacted by the Miller Homestead Fire in 2012; many of the historically surveyed leks within the PAC burned over during that fire, likely contributing to the serious population decline observed in the PAC over time (Figure A1.20). Aerial lek searches were conducted in the PAC in 2018. No new leks were located during those searches, suggesting that the observed population decline is due to a true reduction in population as opposed to shifts in lek distribution following the fire.

Folly Farm/Saddle Butte PAC

The Folly Farm/Saddle Butte PAC (often simply referred to as the Folly Farm PAC) is situated in central Harney and Malheur Counties, and is similarly split between the Burns and Vale BLM Districts (Figure A1.1). Twenty leks, comprising 15 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1982, however until 2005 surveys were only consistently conducted at a single lek site (Figure A1.21). Survey effort in the PAC increased substantially in 2014, thus caution should be employed when interpreting population trend data for the PAC during the 2005 – 2013 period (Figure A1.22).

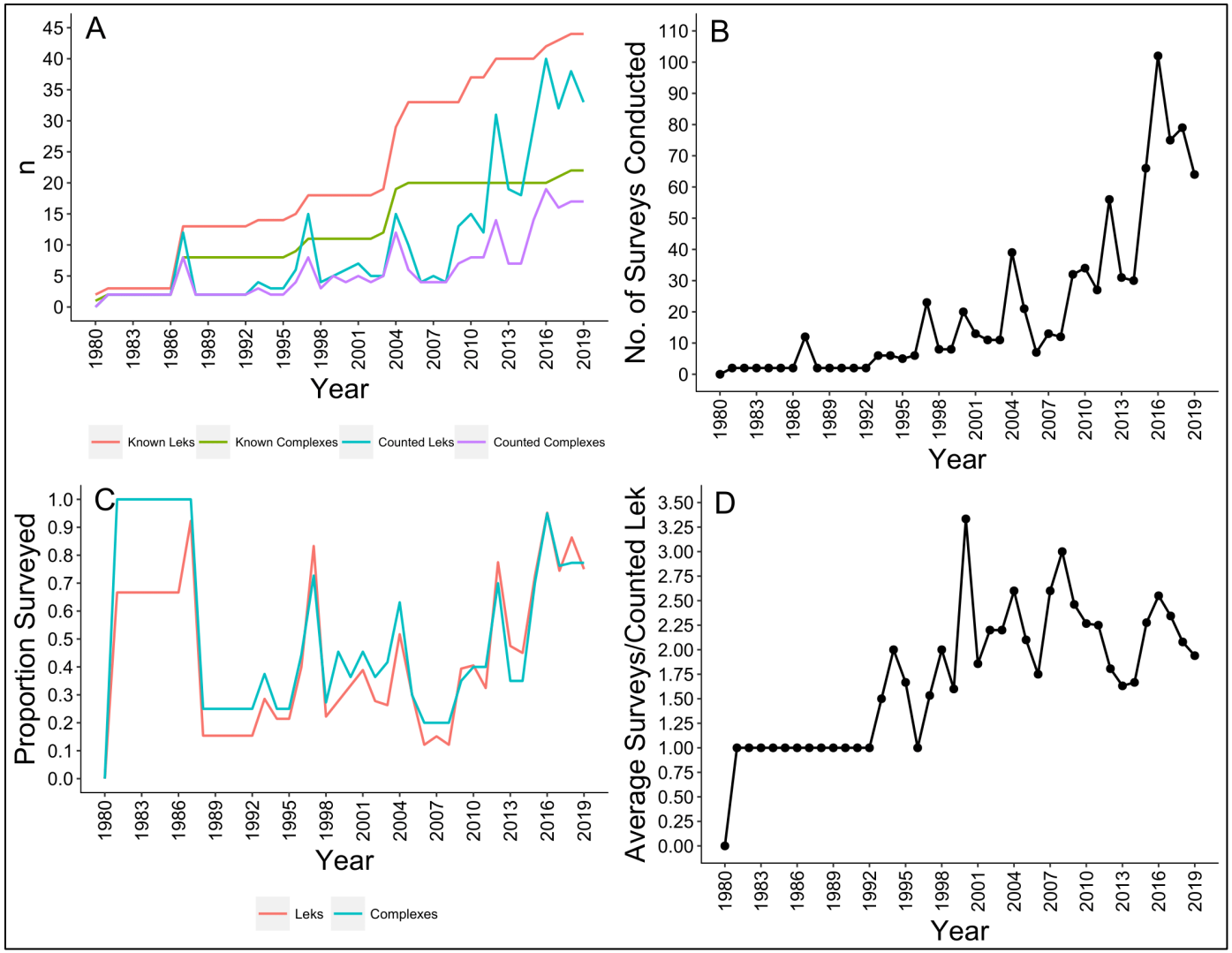


Figure A1.17. **Drewsey PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

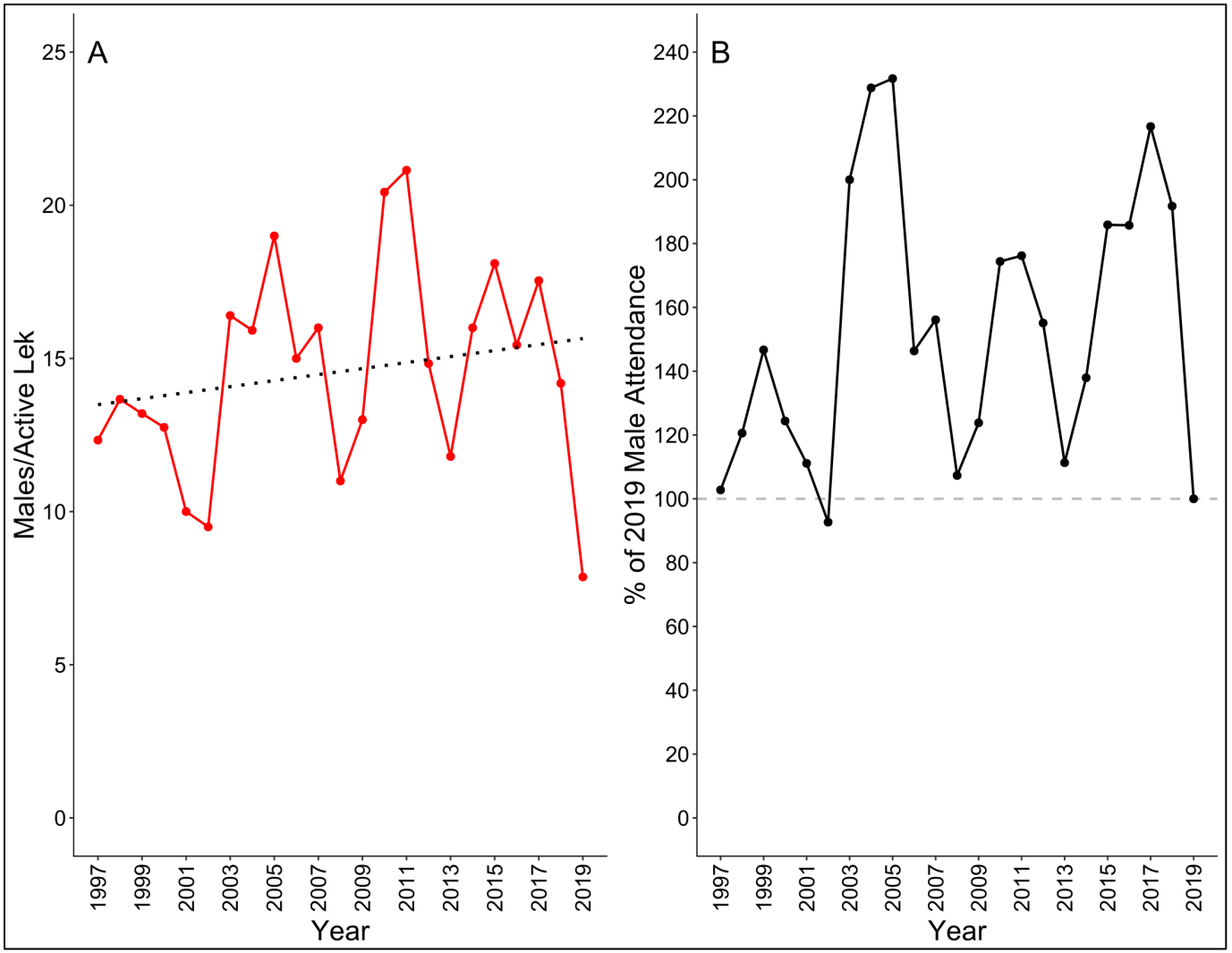


Figure A1.18. Greater sage-grouse population trend in the **Drewsey PAC**, 1997 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

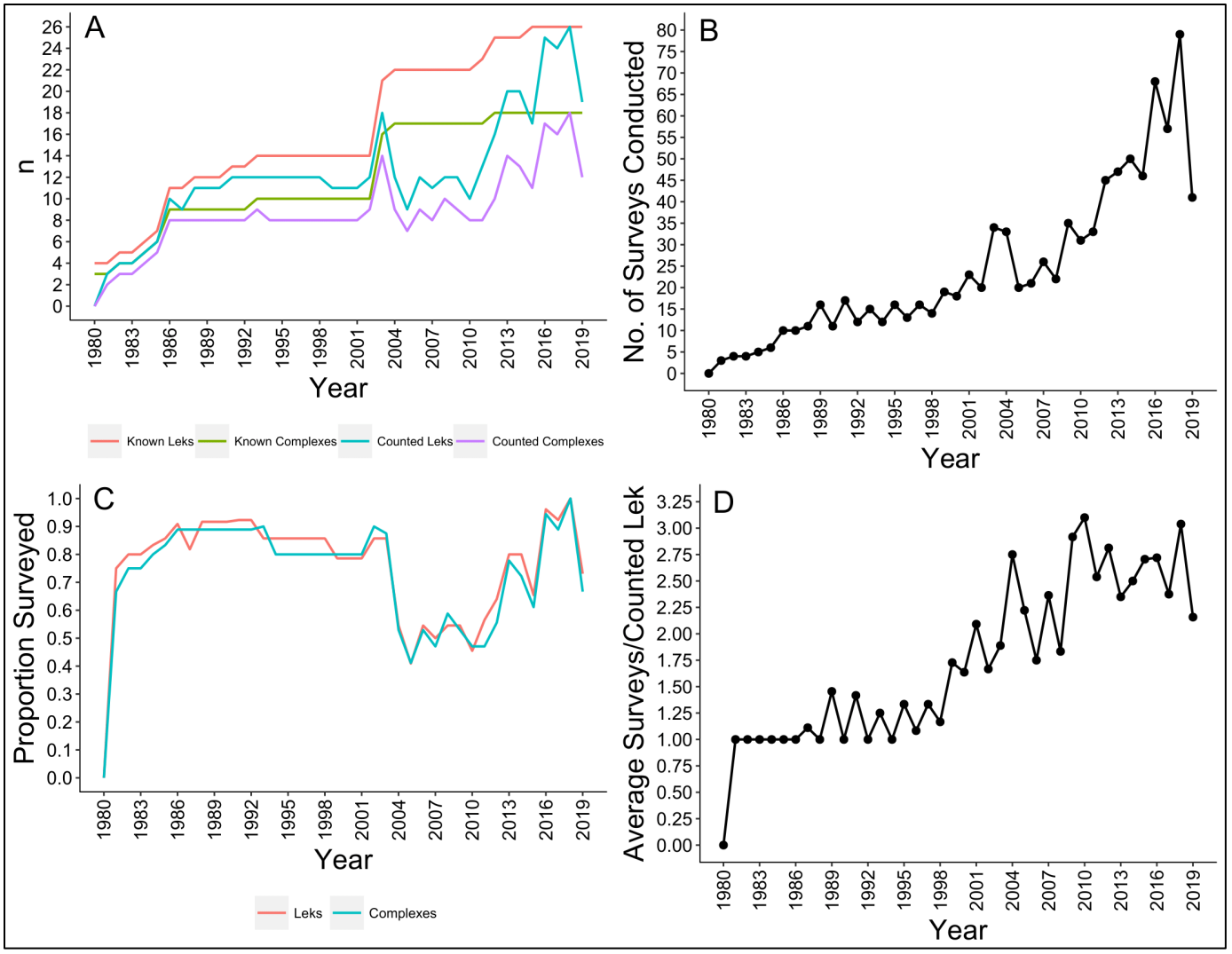


Figure A1.19. **Dry Valley/Jack Mountain PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

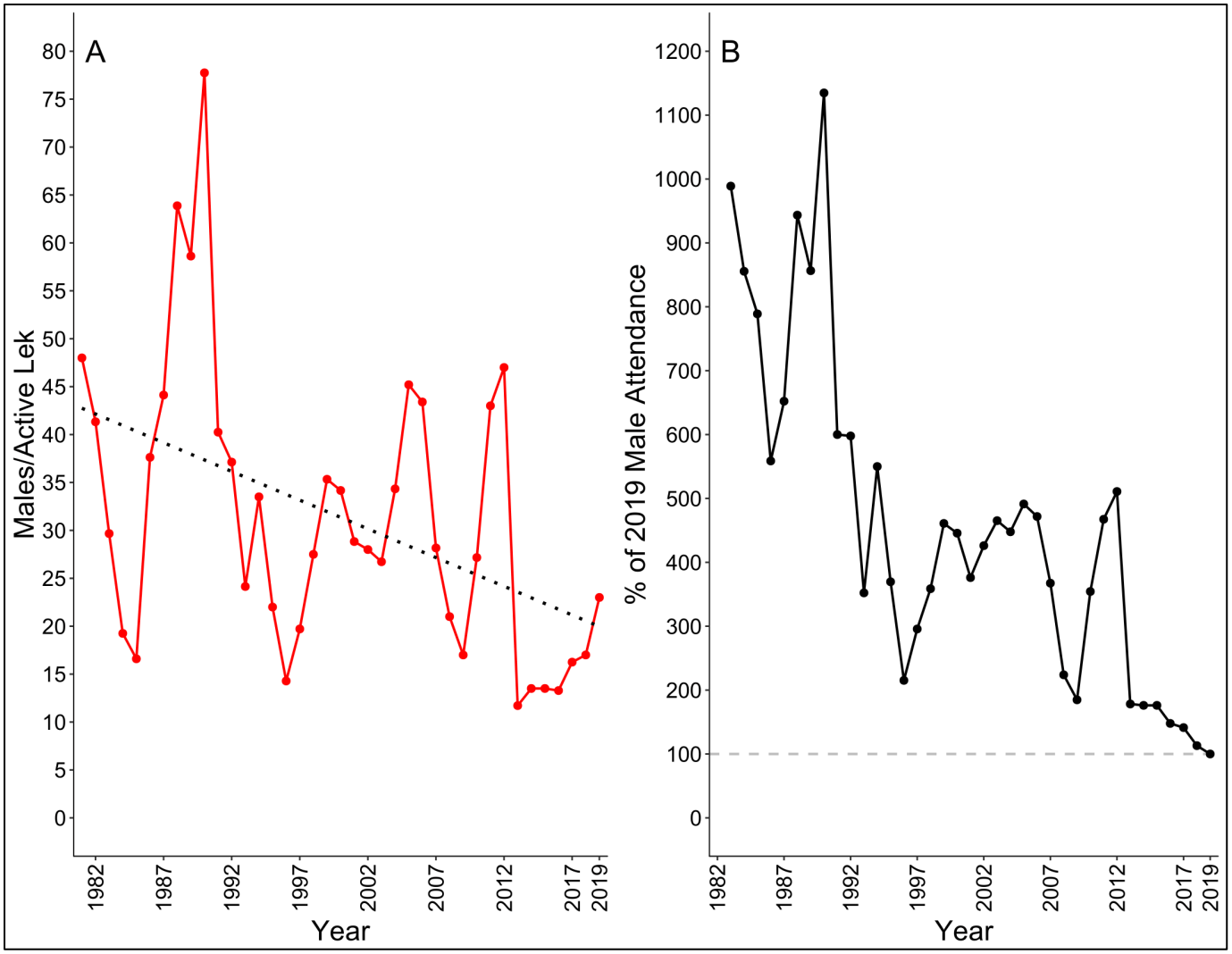


Figure A1.20. Greater sage-grouse population trend in the **Dry Valley/Jack Mountain PAC**, 1981 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

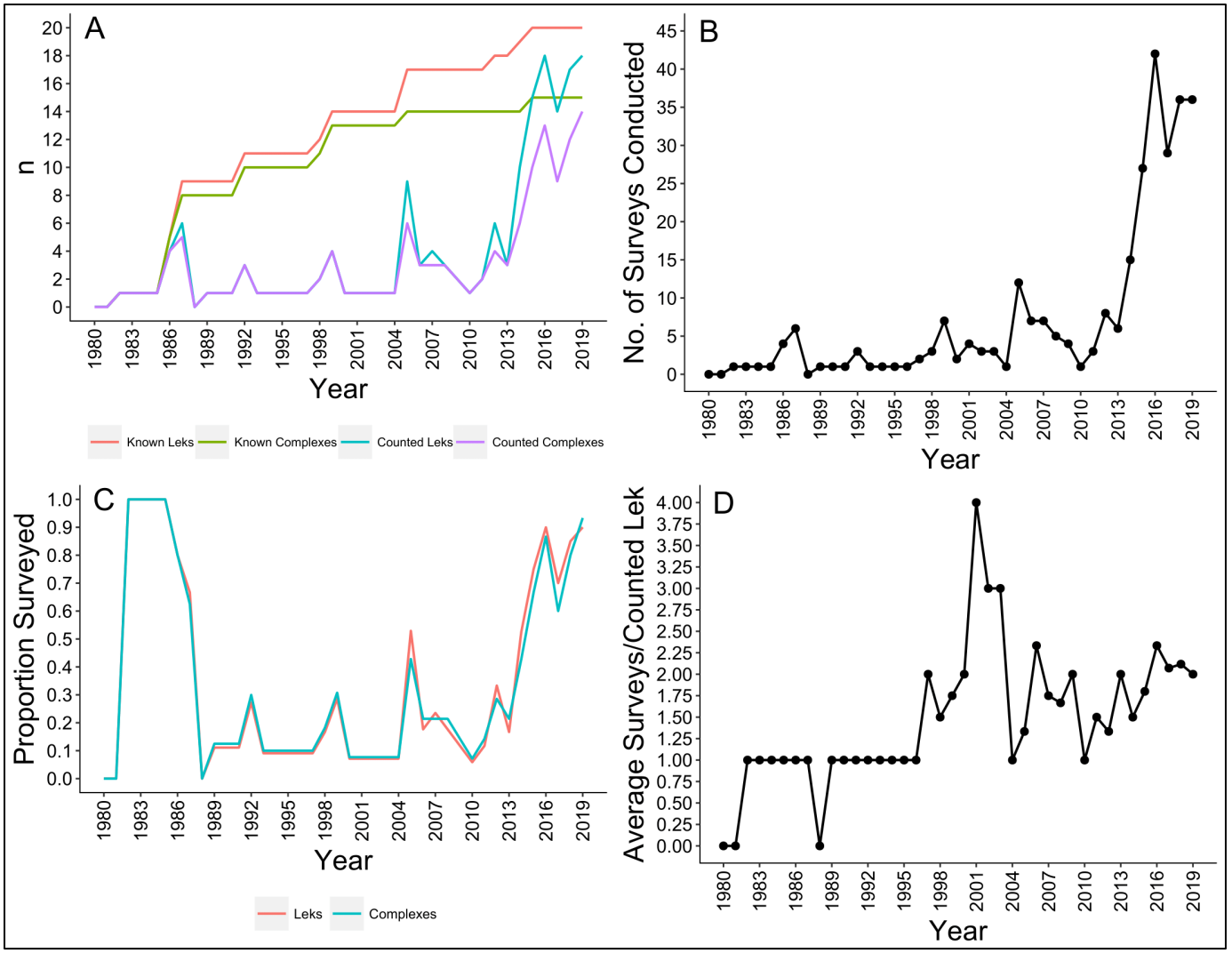


Figure A1.21. **Folly Farm/Saddle Butte PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

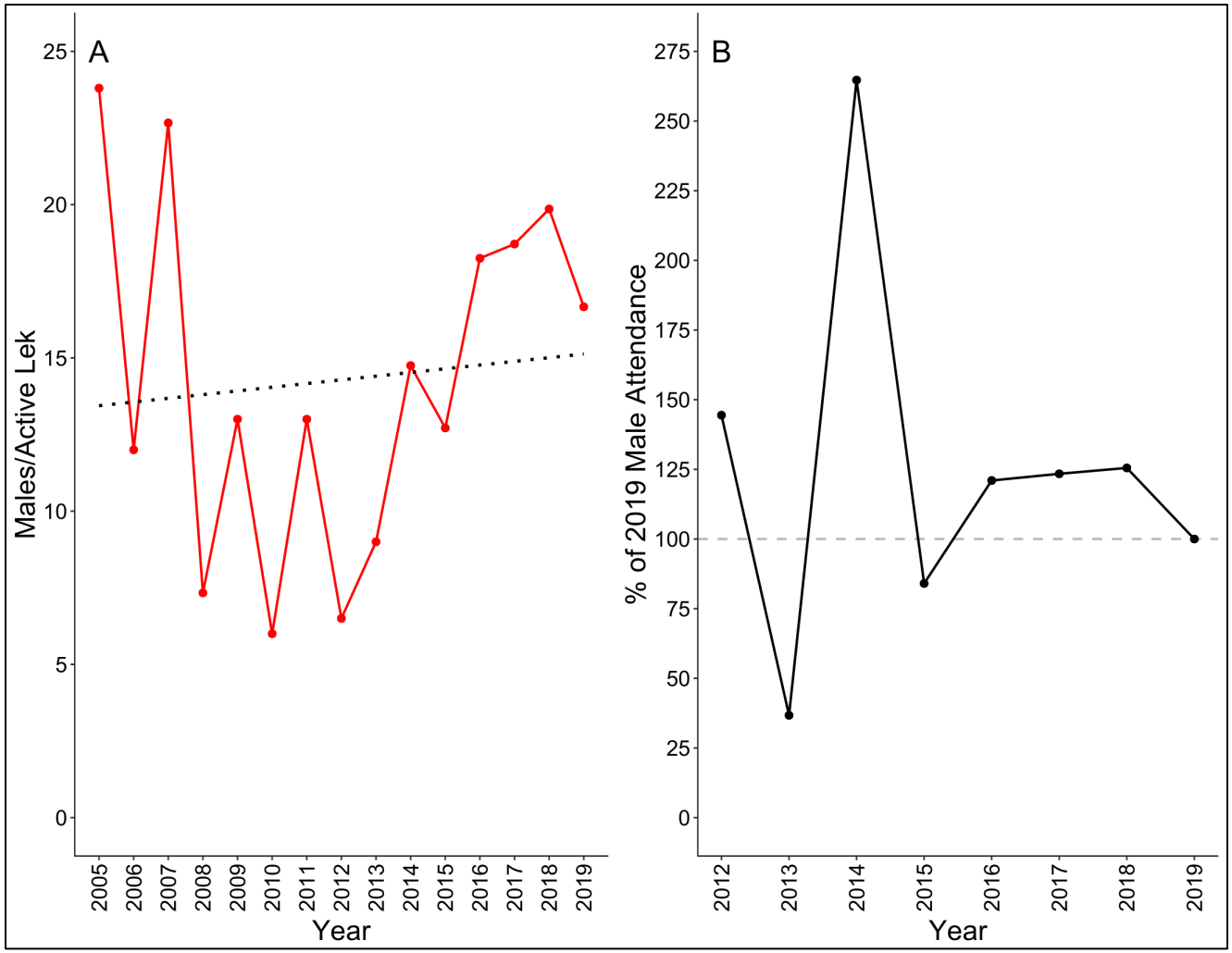


Figure A1.22. Greater sage-grouse population trend in the **Folly Farm/Saddle Butte PAC**, 2005 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019. Difference in time period displayed is due to a lack of common leks counted during both 2019 and the 2005-2012 period.

Louse Canyon PAC

The Louse Canyon PAC is situated in southeastern Malheur County, and completely contained within the Vale BLM District (Figure A1.1). Sixty leks, comprising 51 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1963, however annual surveys were not consistently conducted in the PAC until 2012 (Figure A1.23).

Paulina/12-Mile/Misery Flat PAC

The Paulina/12-Mile/Misery Flat PAC (often referred to simply as the Paulina PAC), is situated in eastern Crook County, with slivers extending into Grant, Harney, and Lake Counties; the PAC is almost entirely within the Prineville BLM District (Figure A1.1). Sixty leks, comprising 33 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1969, however surveys were not conducted consistently at a significant portion of leks within the PAC until 1988 (Figure A1.25).

Picture Rock PAC

The Picture Rock PAC is situated in central Lake County, and completely contained within the Lakeview BLM District (Figure A1.1). Seven leks, comprising 4 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1958, however annual surveys were not conducted consistently until 1981 (Figure A1.27).

Pueblo/S. Steens PAC

The Pueblo/S. Steens PAC (often referred to simply as the Pueblo PAC) is situated in southern Harney County, and is completely contained within the Burns BLM District (Figure A1.1). Thirty leks, comprising 19 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded at leks within the PAC in 1959. Surveys have been conducted annually within the PAC since 1996, however a significant portion of leks within the PAC were not surveyed consistently until 2015 (Figure A1.29). Population trend data is presented for the Pueblo PAC from 1996 - 2019 (Figure A1.30), however due to the low proportion of leks surveyed annually prior to 2015, caution should be taken when interpreting this information.

Soldier Creek PAC

The Soldier Creek PAC is situated in southeastern Malheur County, and is completely contained within the Vale BLM District (Figure A1.1). Forty-seven leks, comprising 32 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1972, and annual surveys have been conducted at leks within the PAC since 1991 (Figure A1.31). A significant proportion of known leks within the PAC were first surveyed in 1993, however from 1996 – 2005 only two complexes were consistently surveyed. Population trend data is presented for the Soldier Creek PAC from 1993 - 2019 (Figure A1.32), however due to the low proportion of leks surveyed annually prior to 2006, caution should be taken when interpreting this information.

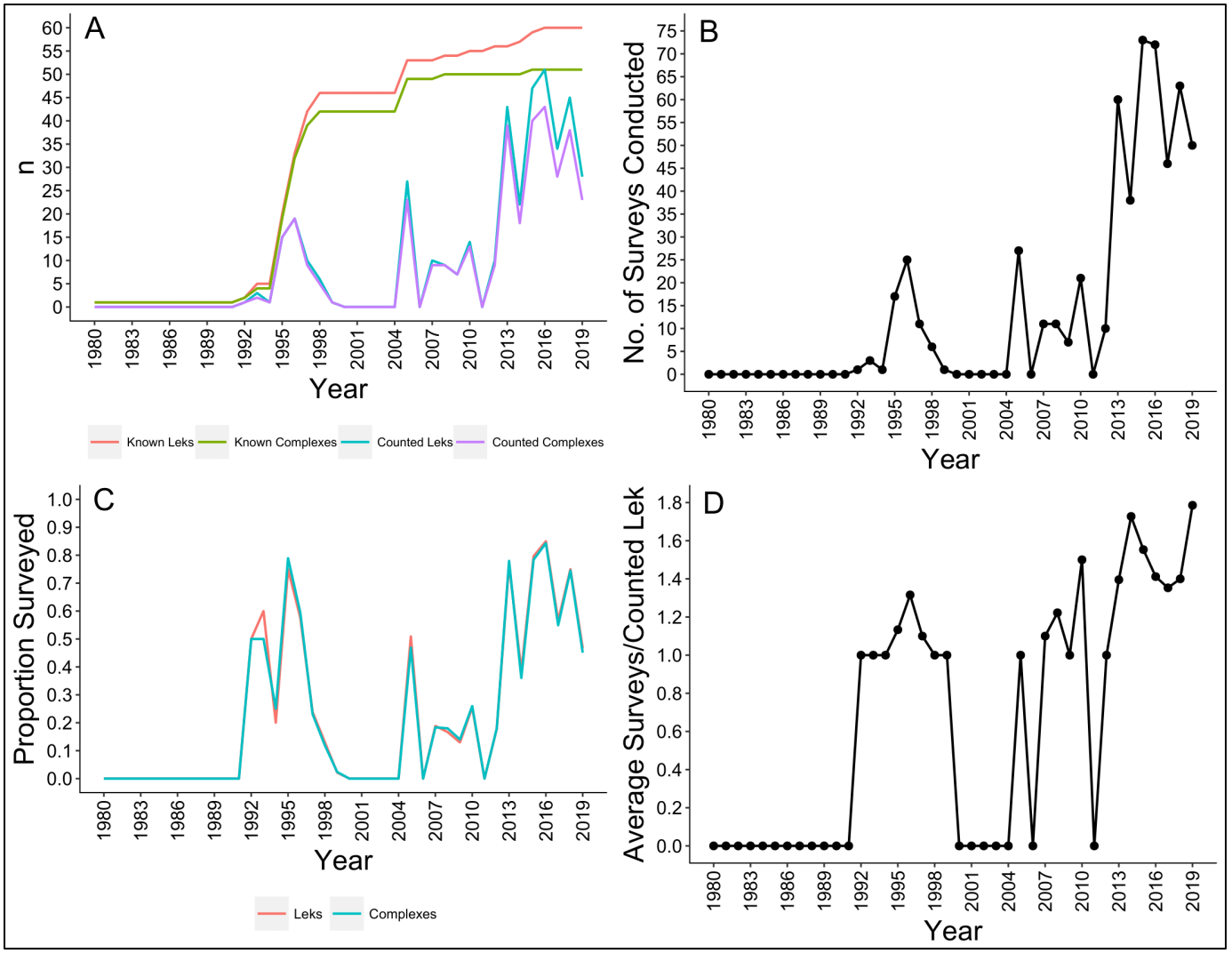


Figure A1.23. **Louse Canyon PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

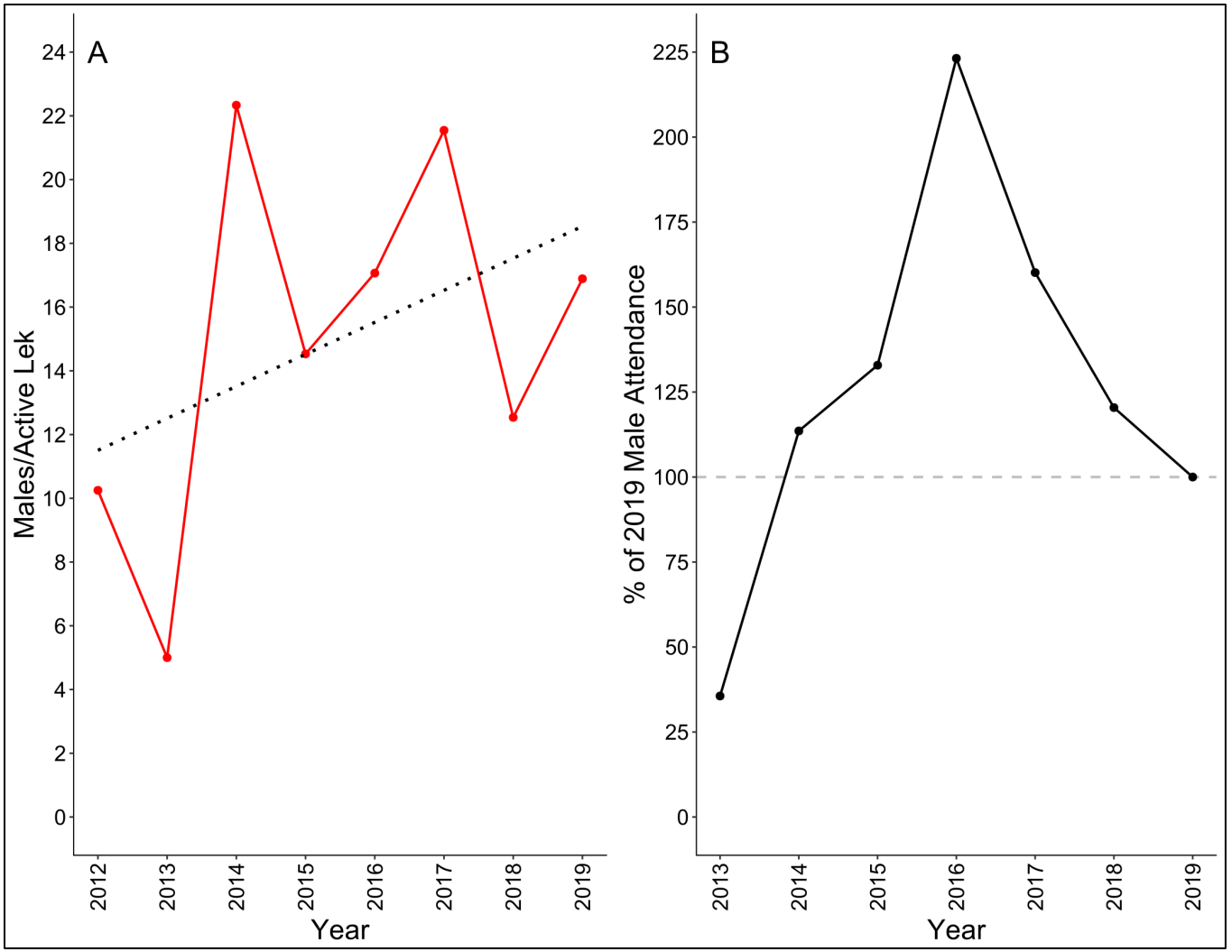


Figure A1.24. Greater sage-grouse population trend in the **Louse Canyon PAC**, 2012 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

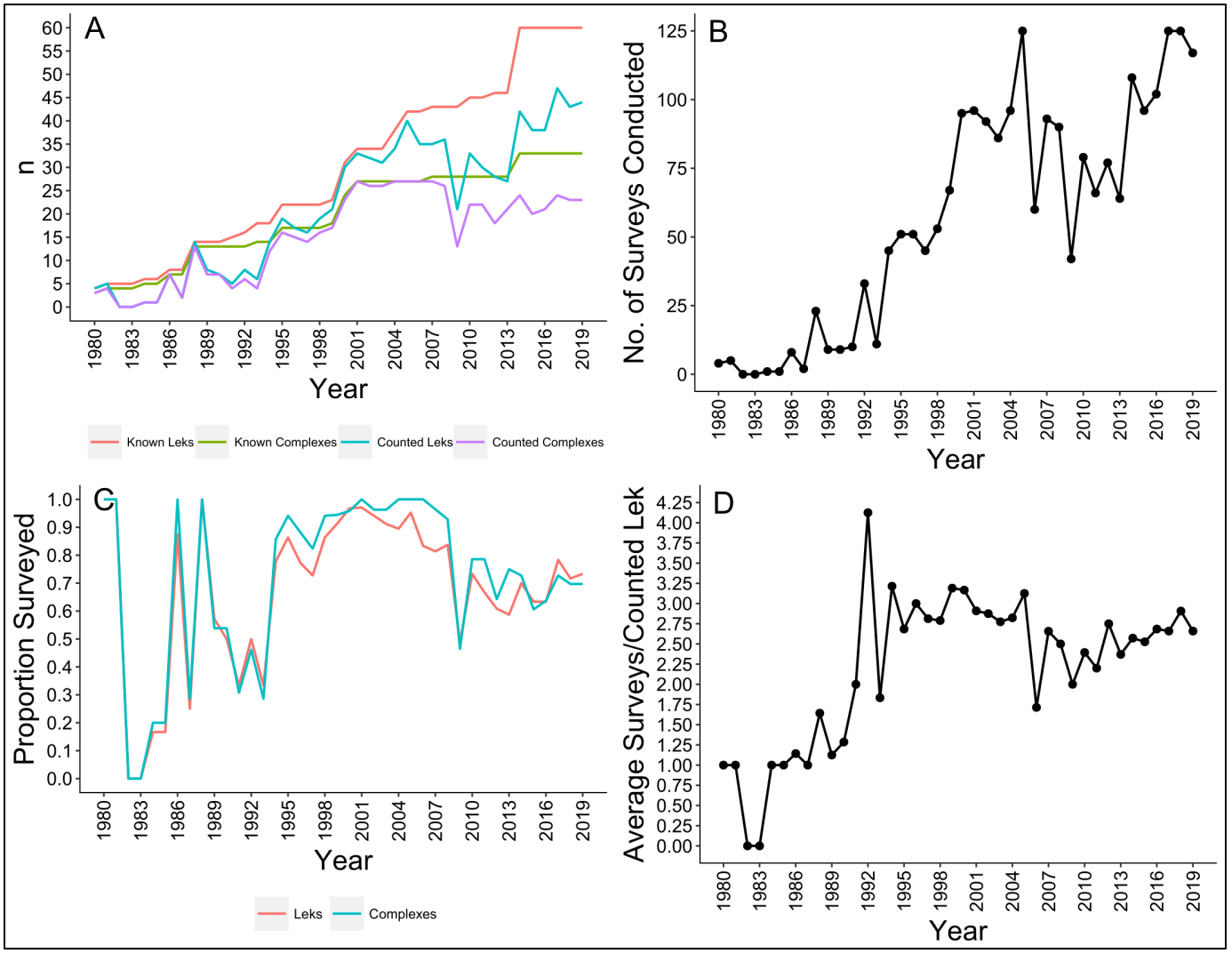


Figure A1.25. **Paulina/12-Mile/Misery Flat PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

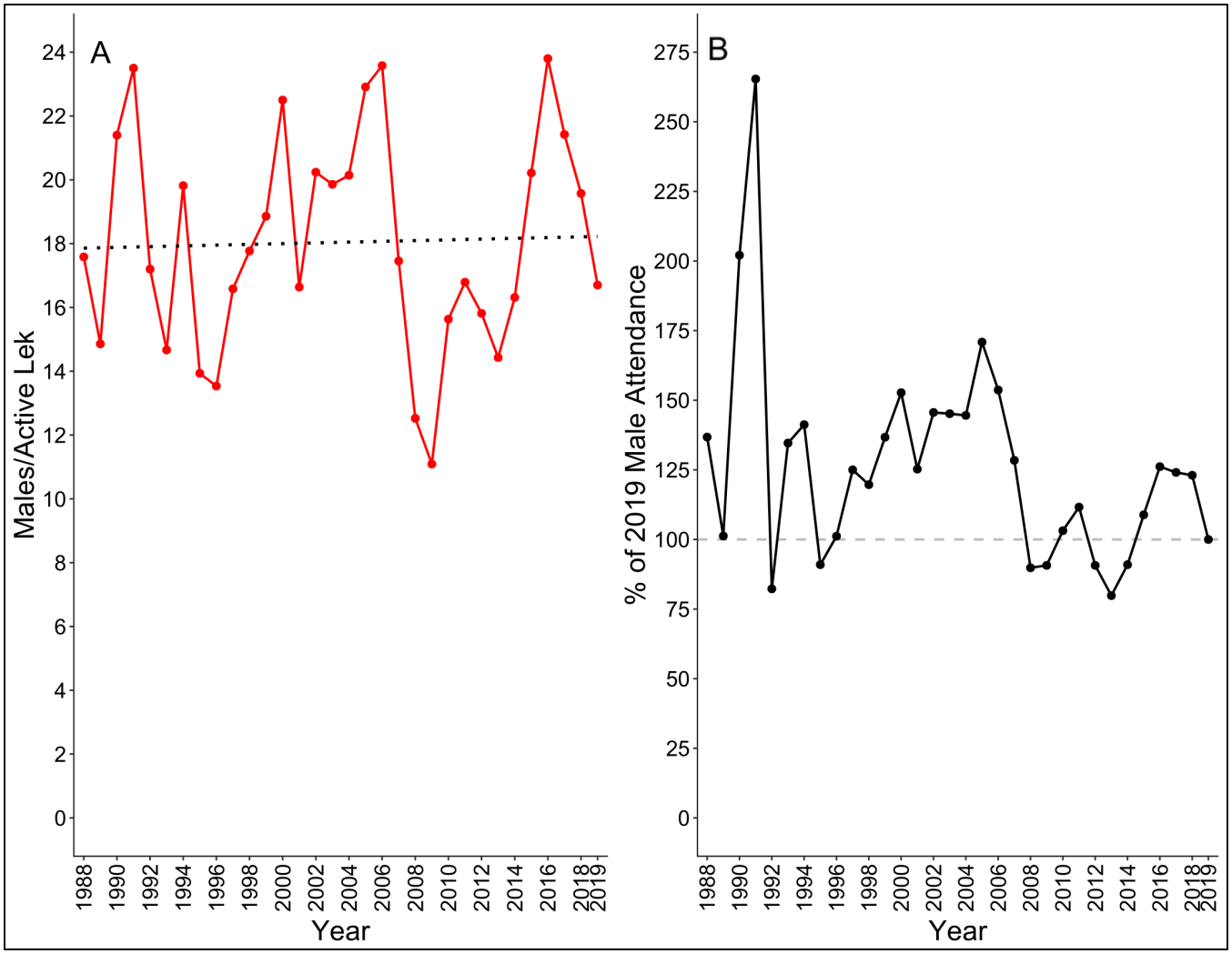


Figure A1.26. Greater sage-grouse population trend in the **Paulina/12-Mile/Misery Flat PAC**, 1988 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

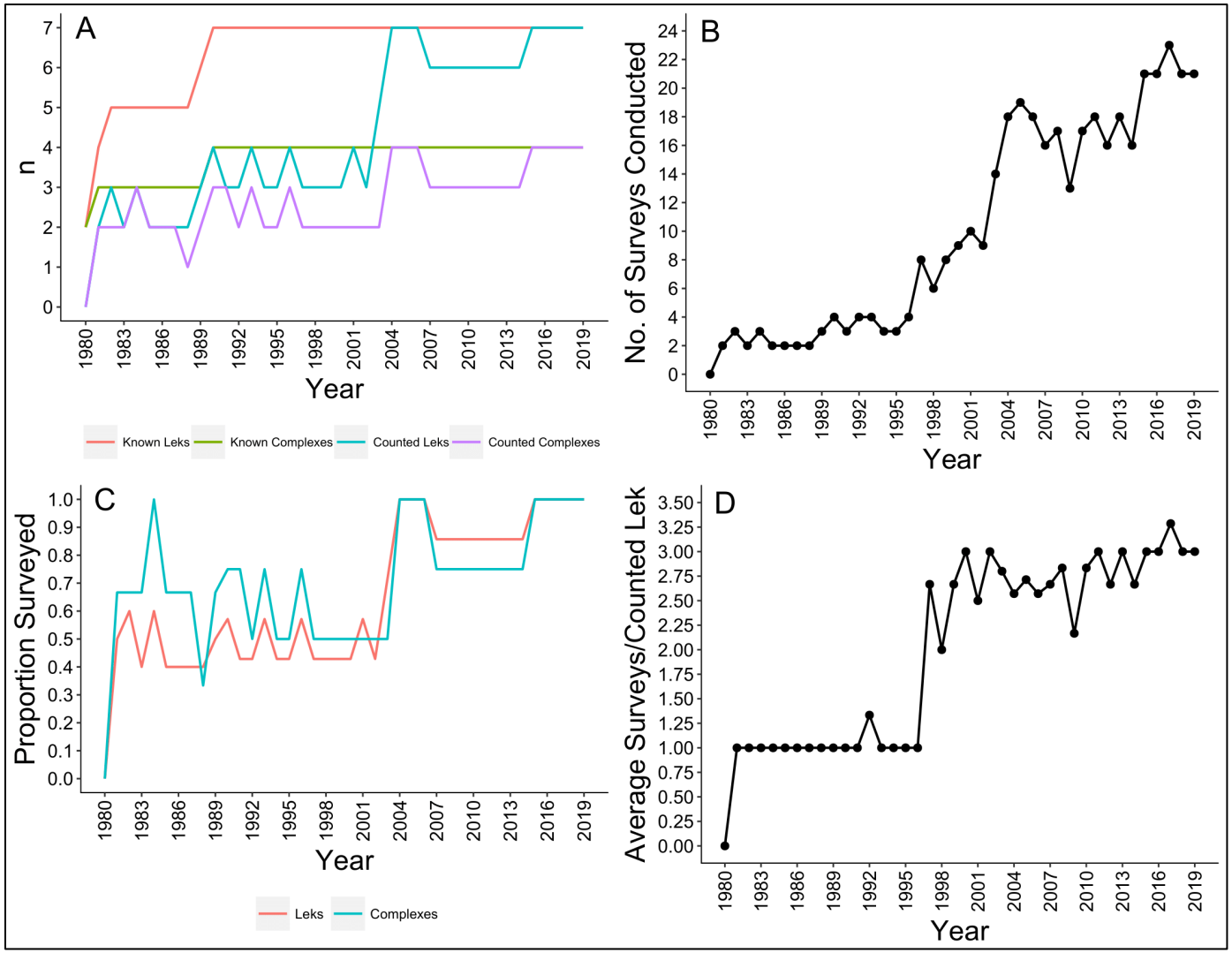


Figure A1.27. **Picture Rock PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

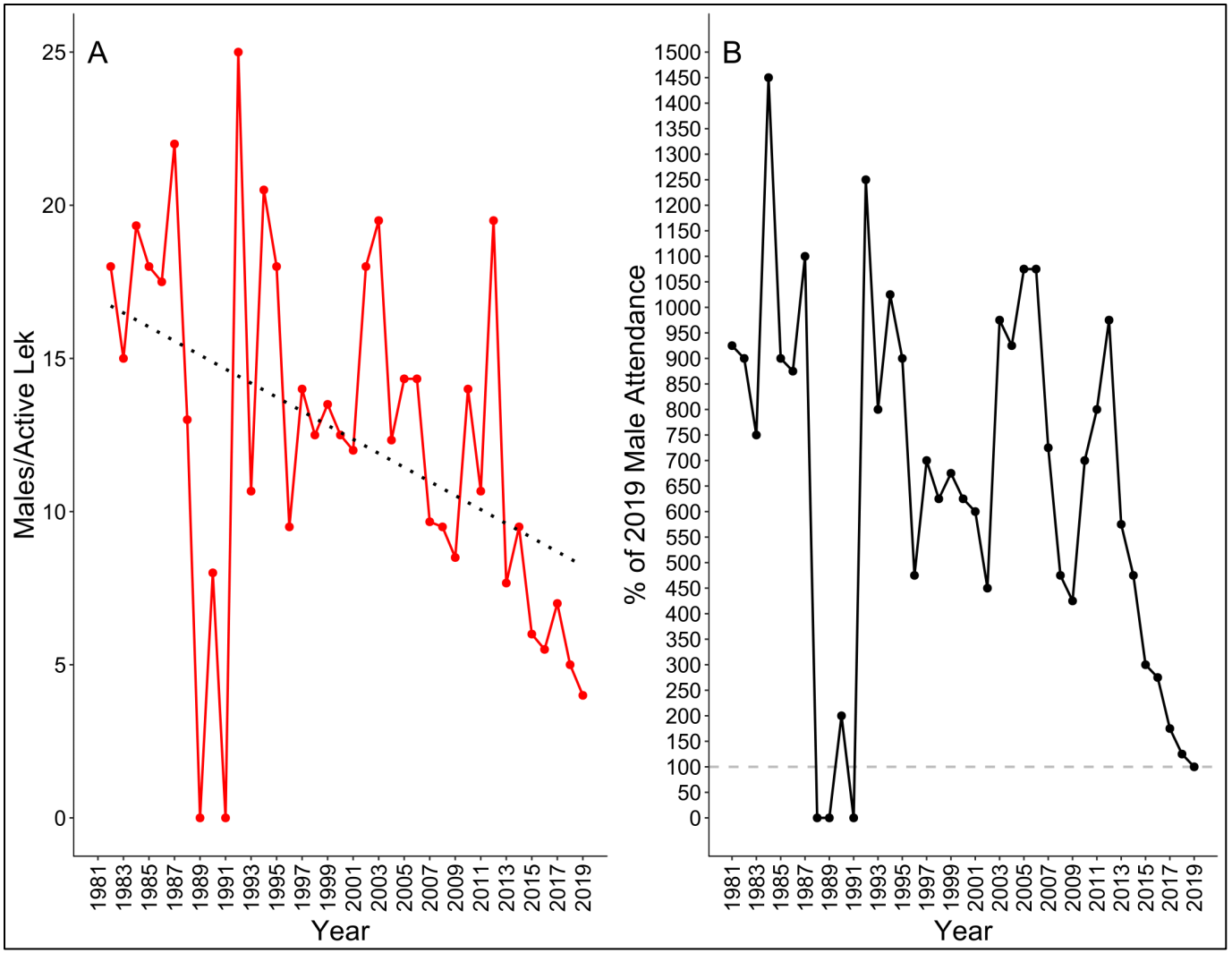


Figure A1.28. Greater sage-grouse population trend in the **Picture Rock PAC**, 1981 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

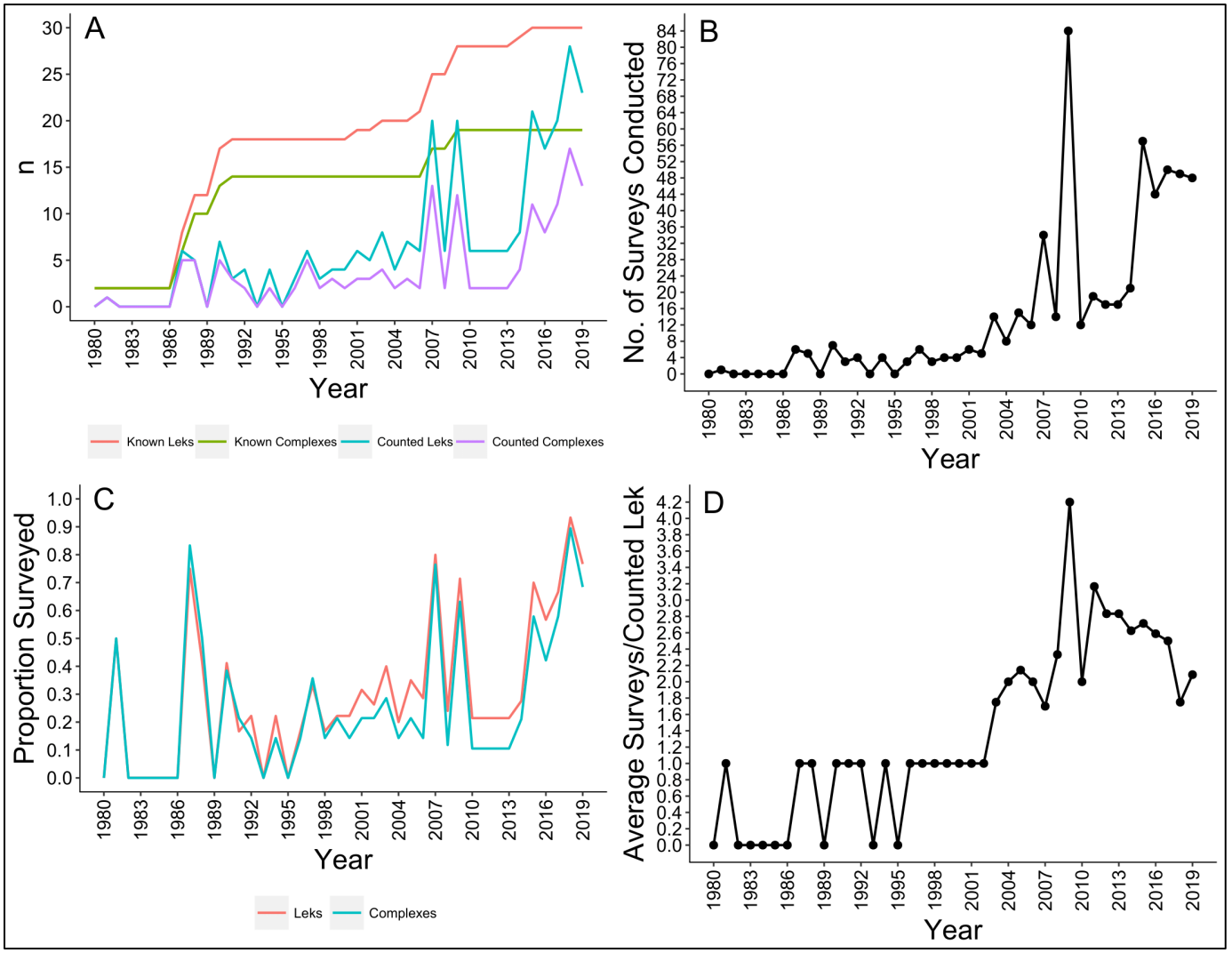


Figure A1.29. **Pueblos/S. Steens PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

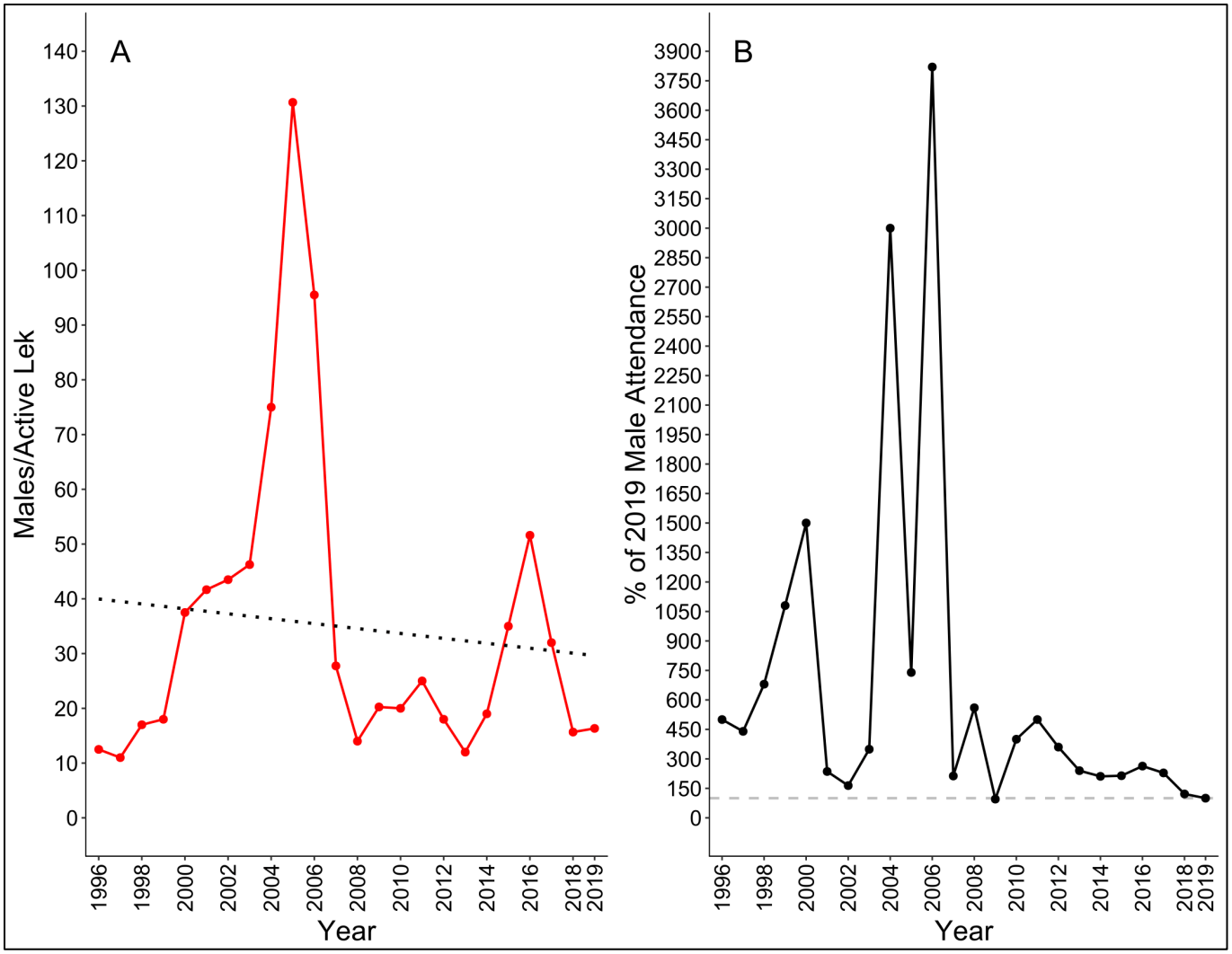


Figure A1.30. Greater sage-grouse population trend in the **Pueblos/S. Steens PAC**, 1996 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

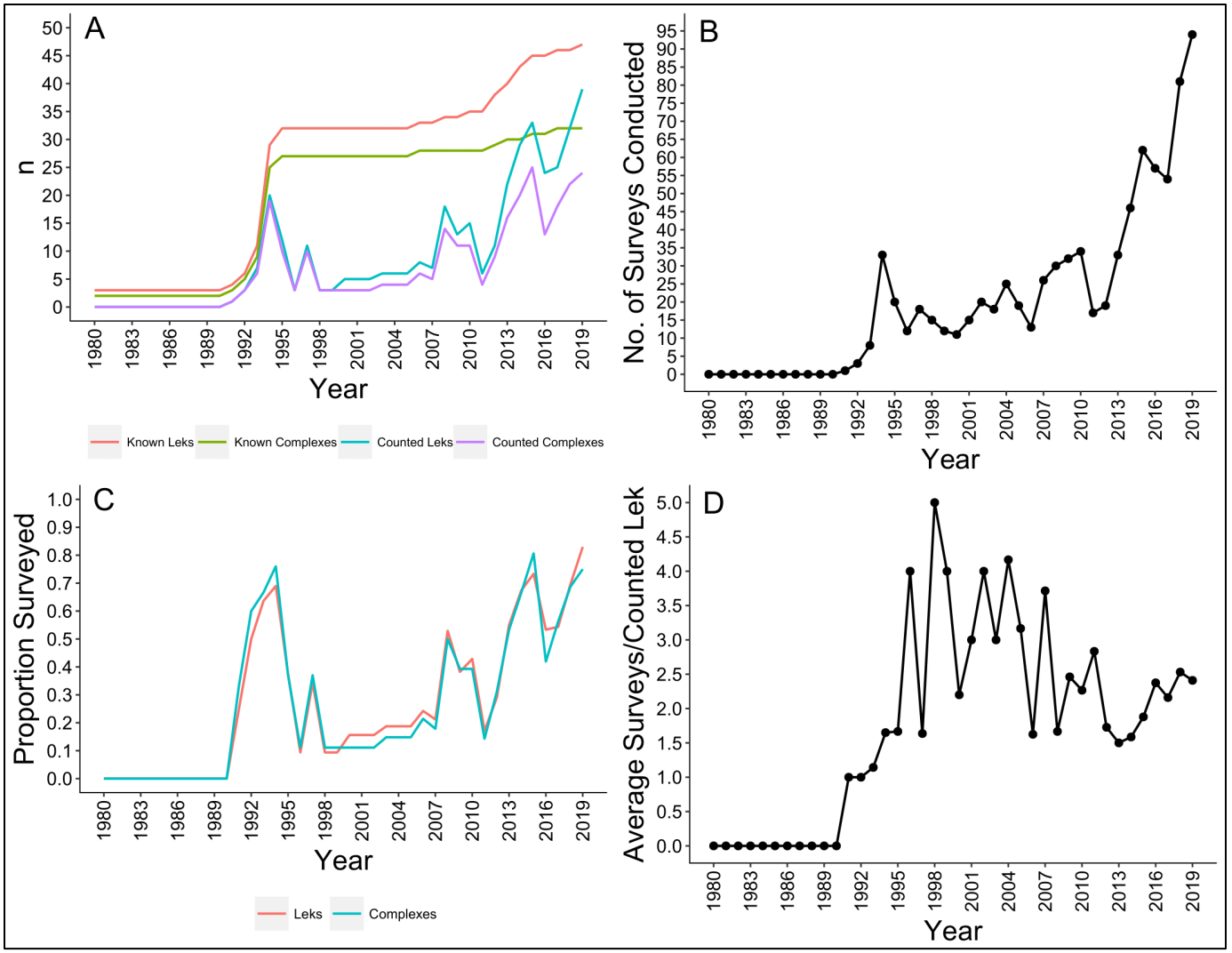


Figure A1.31. **Soldier Creek PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

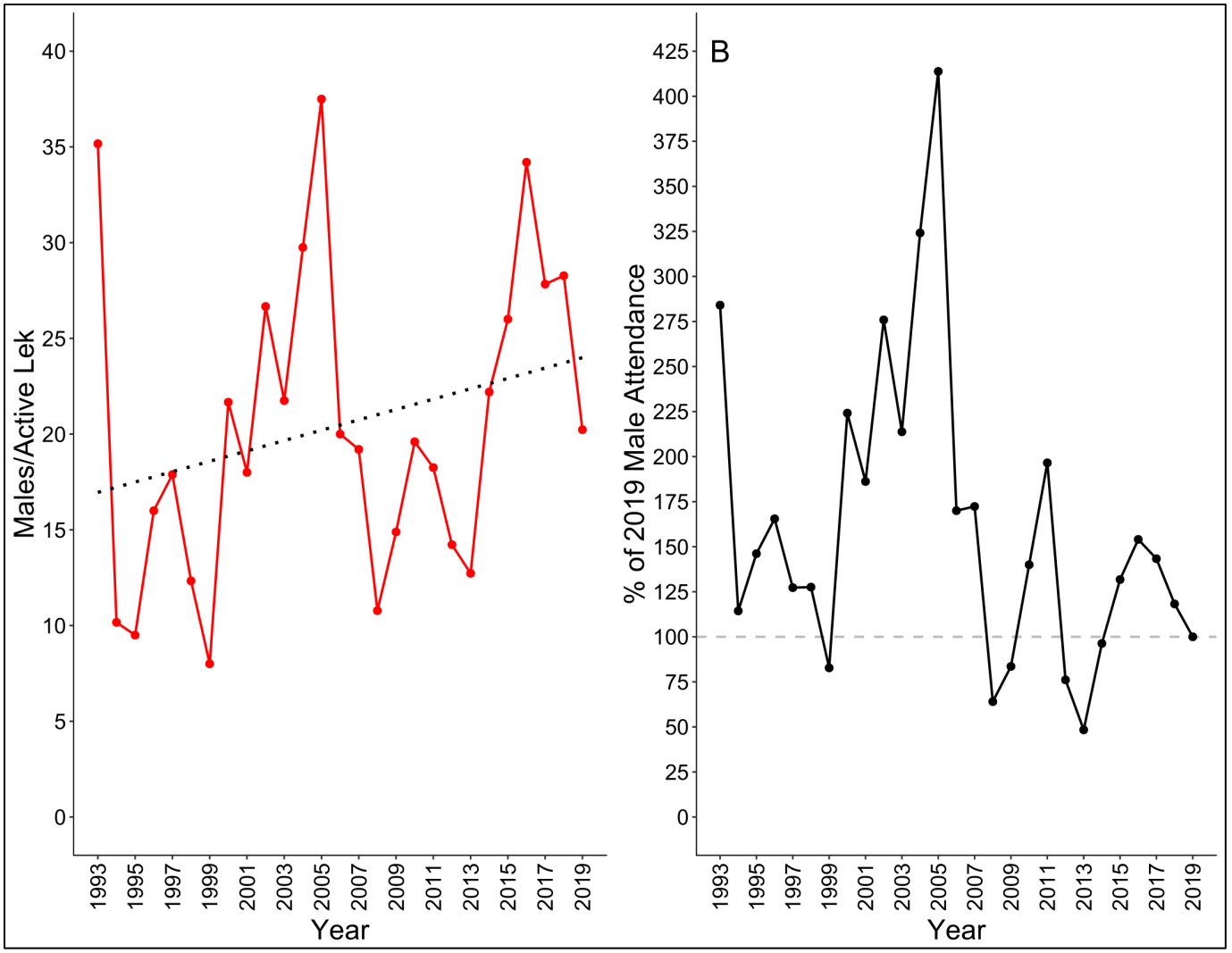


Figure A1.32. Greater sage-grouse population trend in the **Soldier Creek PAC**, 1993 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

Steens PAC

The Steens PAC is situated in central Harney County, and is entirely contained within the Burns BLM District (Figure A1.1). Fifteen leks, comprising 10 complexes are known to exist or have existed within the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1947, and annual lek surveys have been conducted in the PAC since 1981, however until 2005 only two complexes were consistently surveyed in the PAC (Figure A1.33). As such caution should be employed when interpreting population trend data in the PAC prior to 2006 (Figure A1.34).

Trout Creeks PAC

The Trout Creeks PAC is situated in southeastern Harney County, and southwestern Malheur County, and is split between the Burns and Vale BLM Districts (Figure A1.1). Ninety-six leks, comprising 55 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1970, however annual lek surveys were not conducted consistently within the PAC until 2012 (Figure A1.35).

Tucker Hill PAC

The Tucker Hill PAC is situated in southern Lake County, and is entirely contained within the Lakeview BLM District (Figure A1.1). Six leks, comprising four complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1977, and annual surveys have been conducted in the PAC consistently since 1996 (Figure A1.37).

Warners PAC

The Warners PAC is situated in eastern Lake County, and is entirely contained within the Lakeview BLM District (Figure A1.1). Fifty-seven leks, comprising 42 complexes are known to exist or have existed in the PAC (Table A1.1). Surveys were first recorded for leks within the PAC in 1975, and annual surveys have been conducted in the PAC consistently since 1993 (Figure A1.39). The number of leks known to exist within the PAC increased substantially following aerial lek searches conducted in 2002.

Leks Outside of PACs

Leks occur outside of PACs throughout the range of sage-grouse in Oregon (Figure A1.1). Two hundred thirty-seven leks, comprising 193 complexes occur outside of mapped PACs in the state (Table A1.1). Surveys were first recorded for leks outside of mapped PACs in 1947, and surveys have been conducted annually from 1947 - 2019, survey effort and knowledge of sage-grouse distribution in habitat not mapped as a PAC increased substantially following 1980 (Figure A1.41).

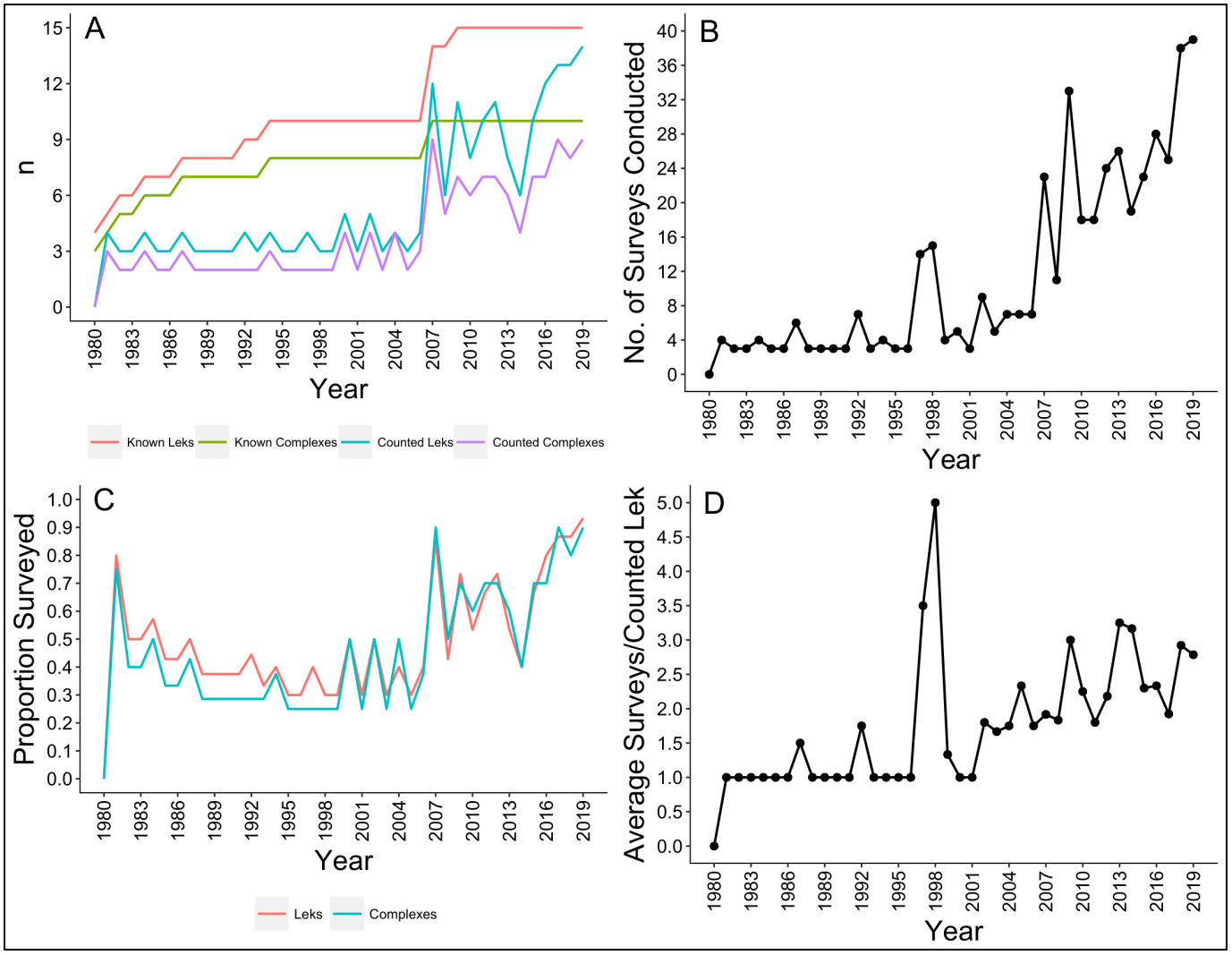


Figure A1.33. **Steens PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

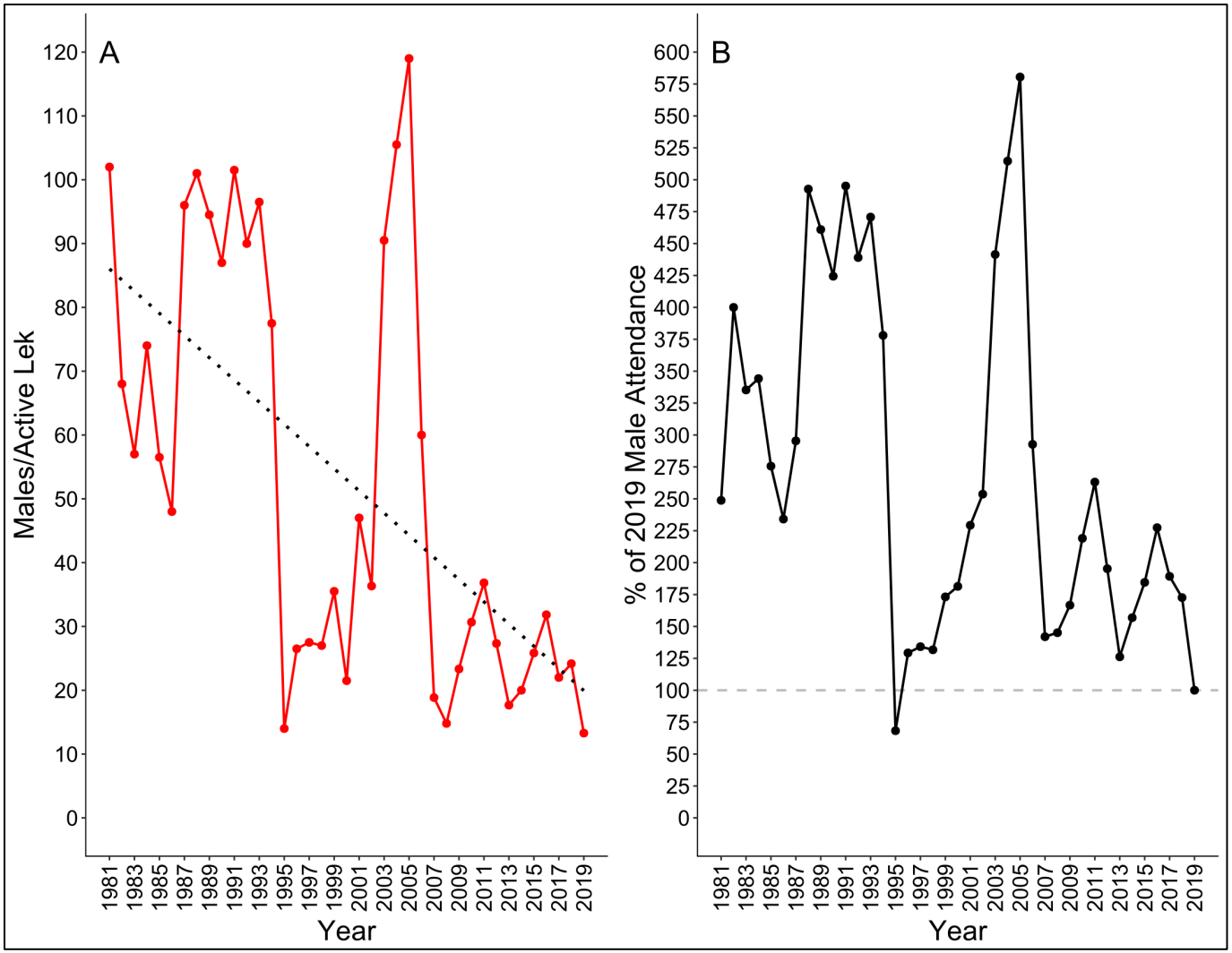


Figure A1.34. Greater sage-grouse population trend in the **Steens PAC**, 1981 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

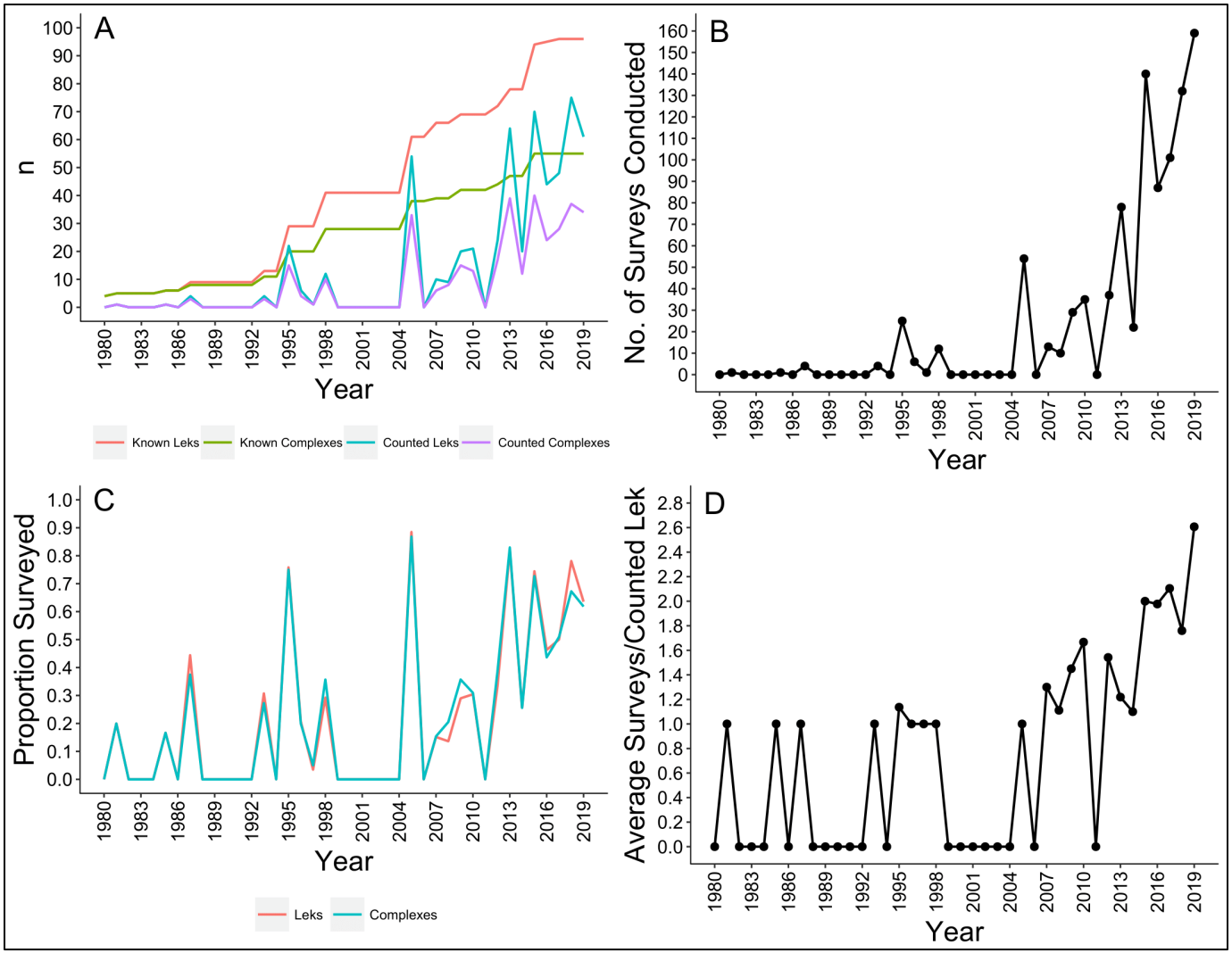


Figure A1.35. **Trout Creeks PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

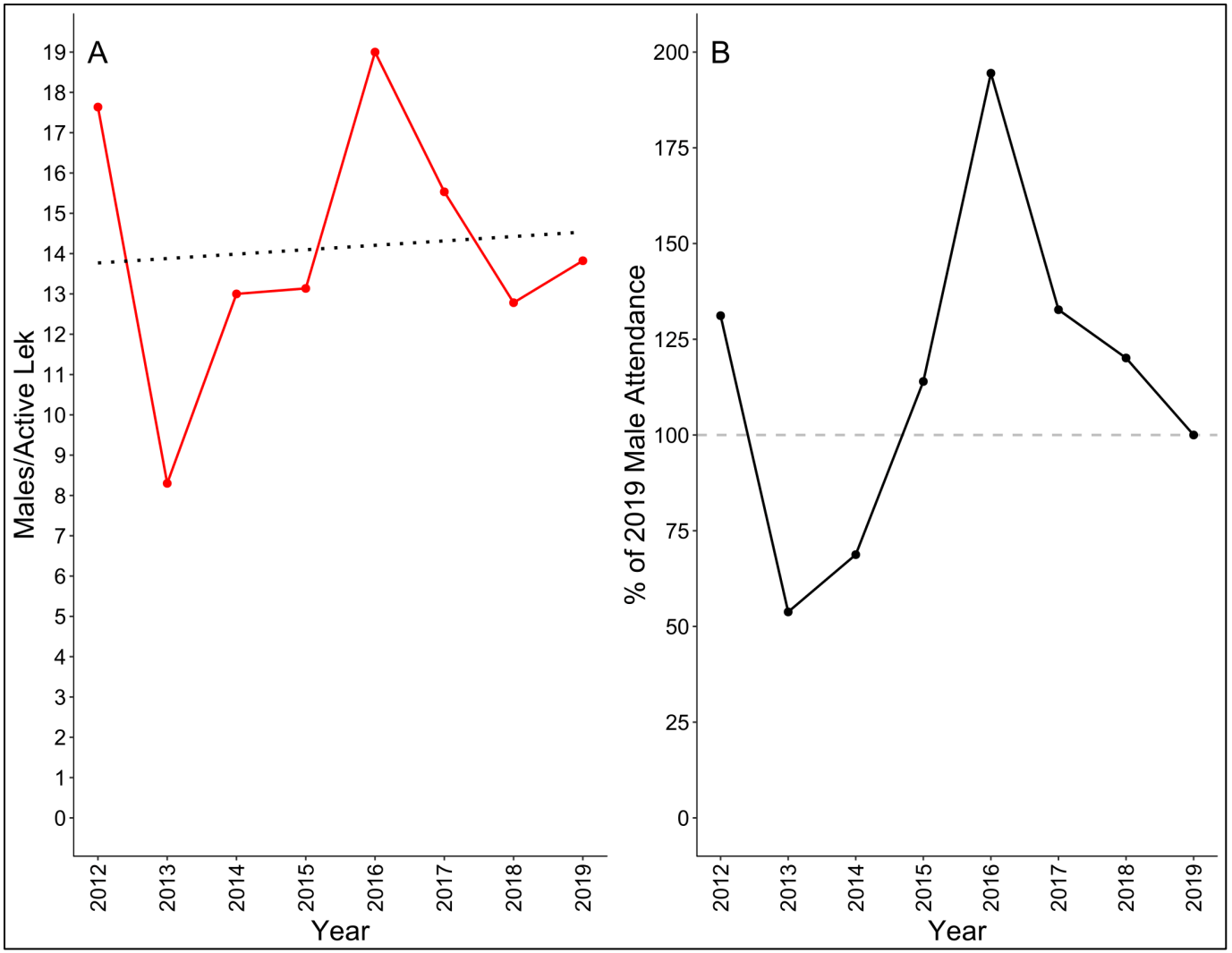


Figure A1.36. Greater sage-grouse population trend in the **Trout Creeks PAC**, 2012 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

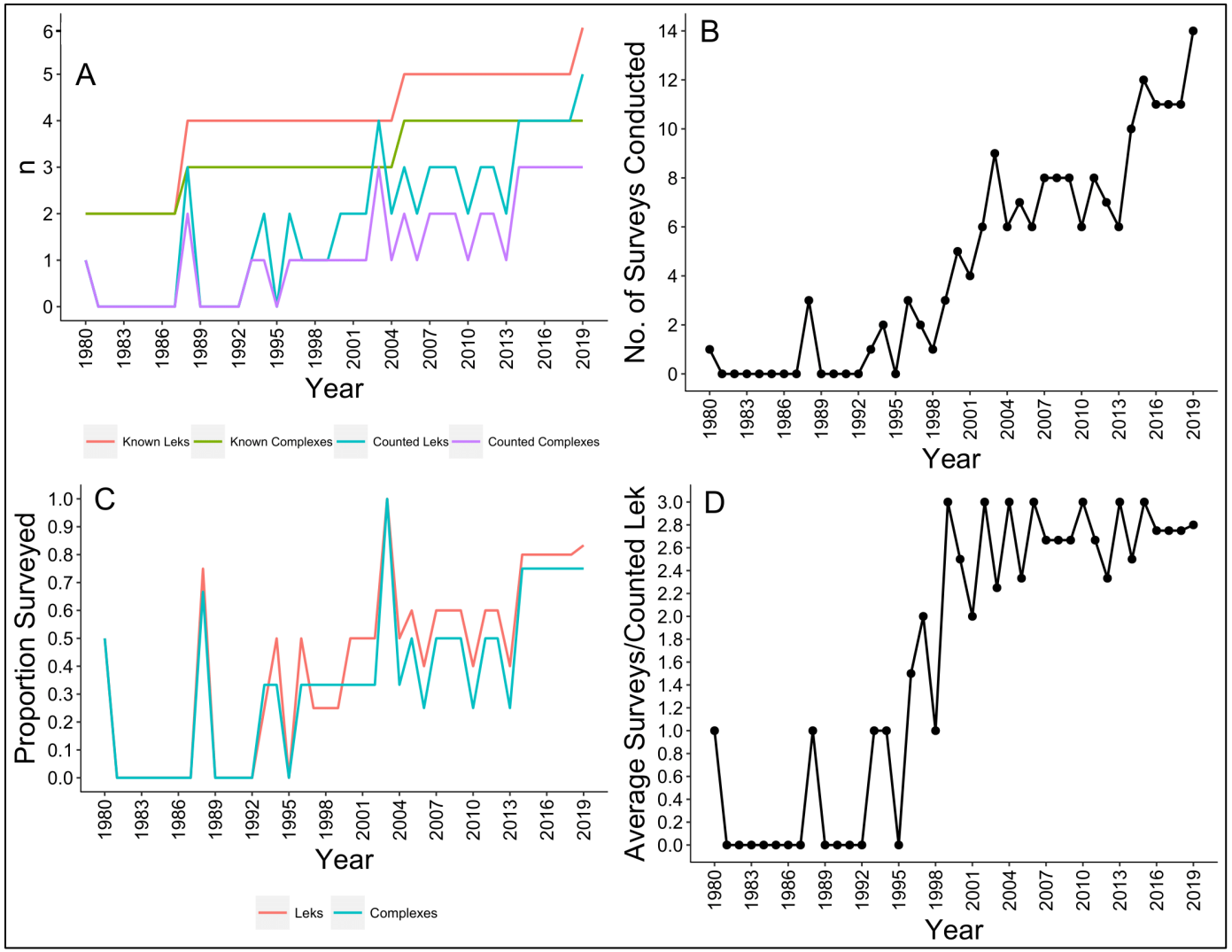


Figure A1.37. **Tucker Hill PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

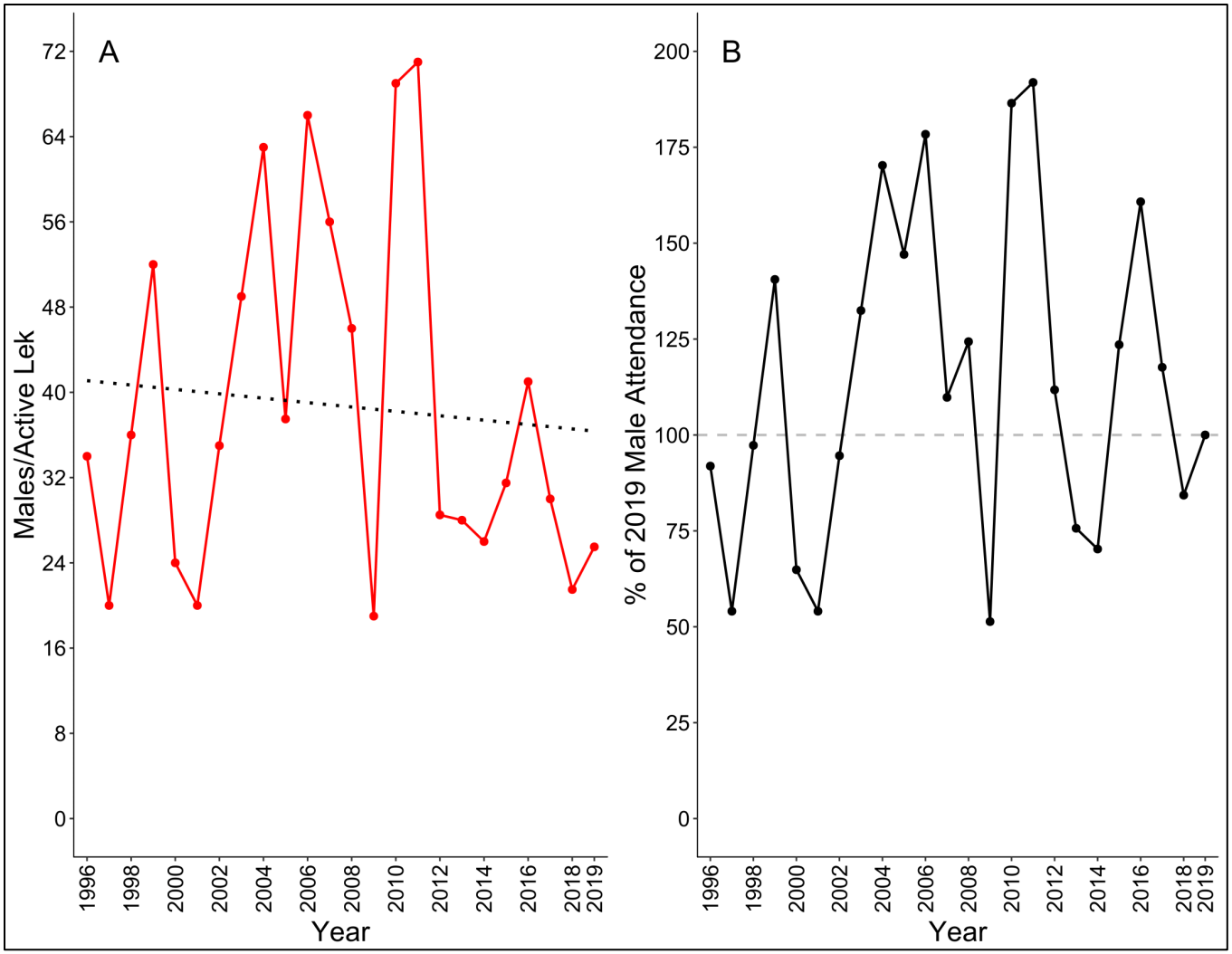


Figure A1.38. Greater sage-grouse population trend in the **Tucker Hill PAC**, 1996 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

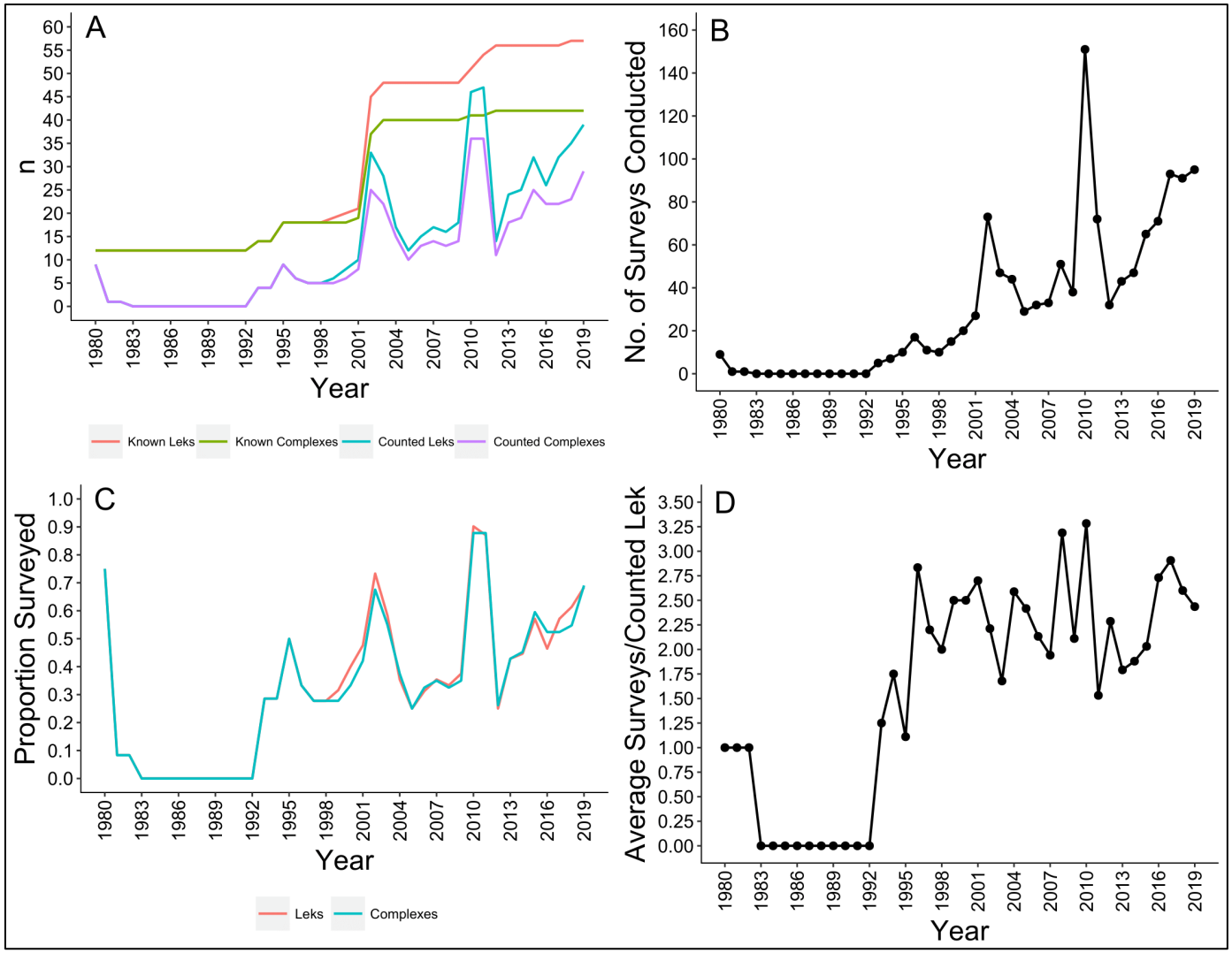


Figure A1.39. **Warners PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

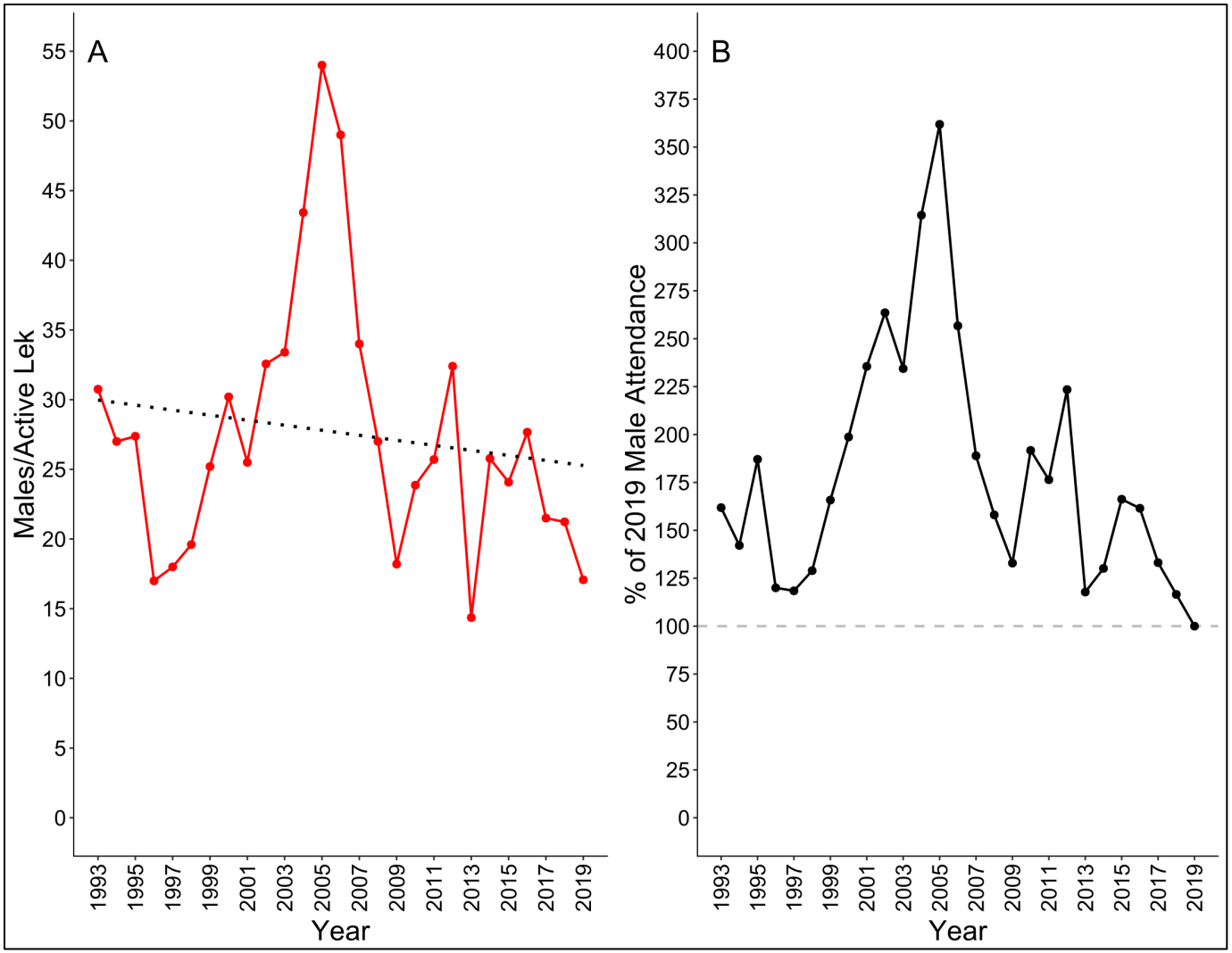


Figure A1.40. Greater sage-grouse population trend in the **Warners PAC**, 1993 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

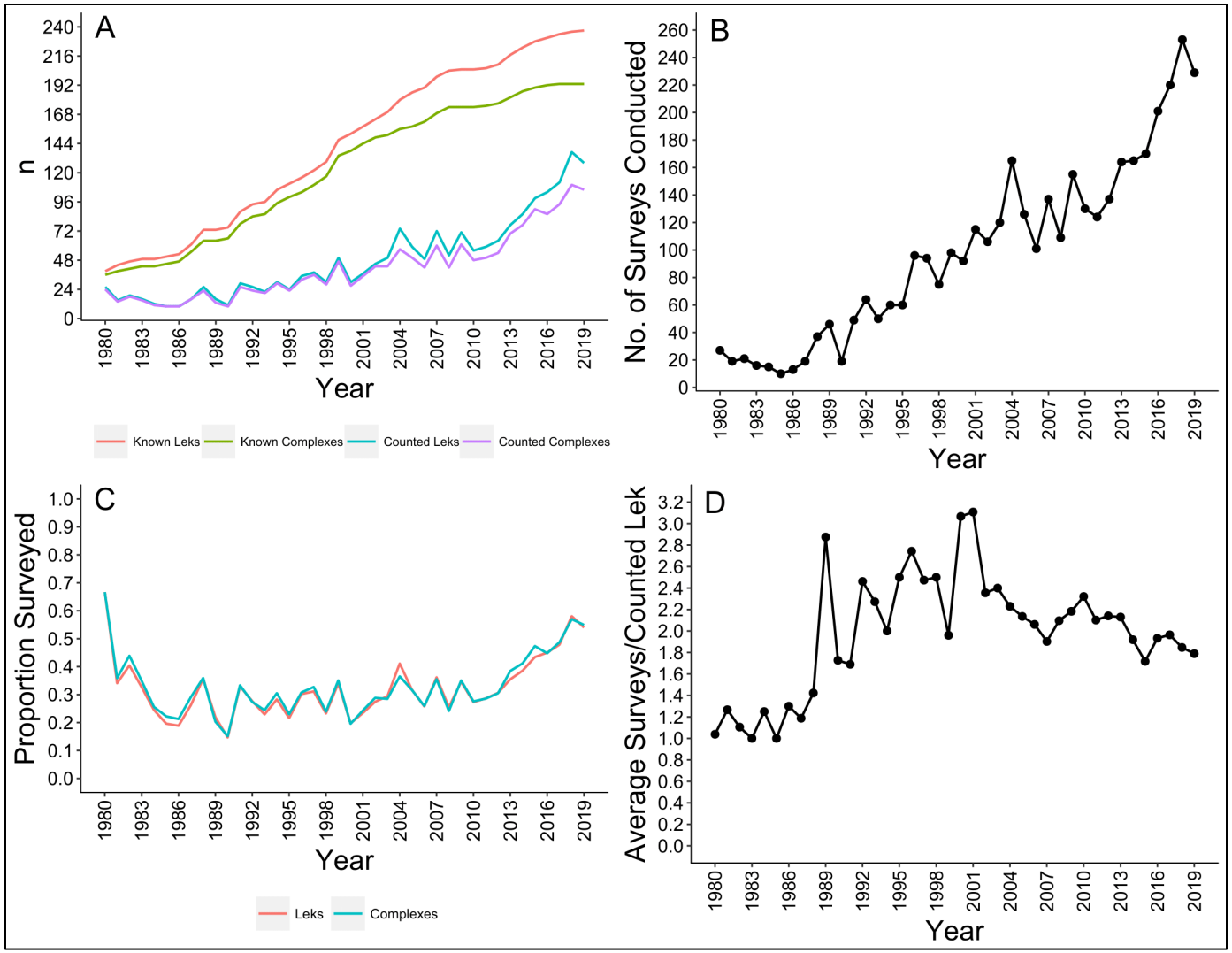


Figure A1.41. **Outside of PAC** greater sage-grouse survey effort statistics, 1980 - 2019. A – Number of leks, and complexes known to exist or have existed, and number of leks and complexes actually surveyed, by year. B – Total number of ground and aerial surveys conducted, by year. C – Proportion of known leks and complex surveyed, by year. D – Average number of surveys conducted at each surveyed lek, by year.

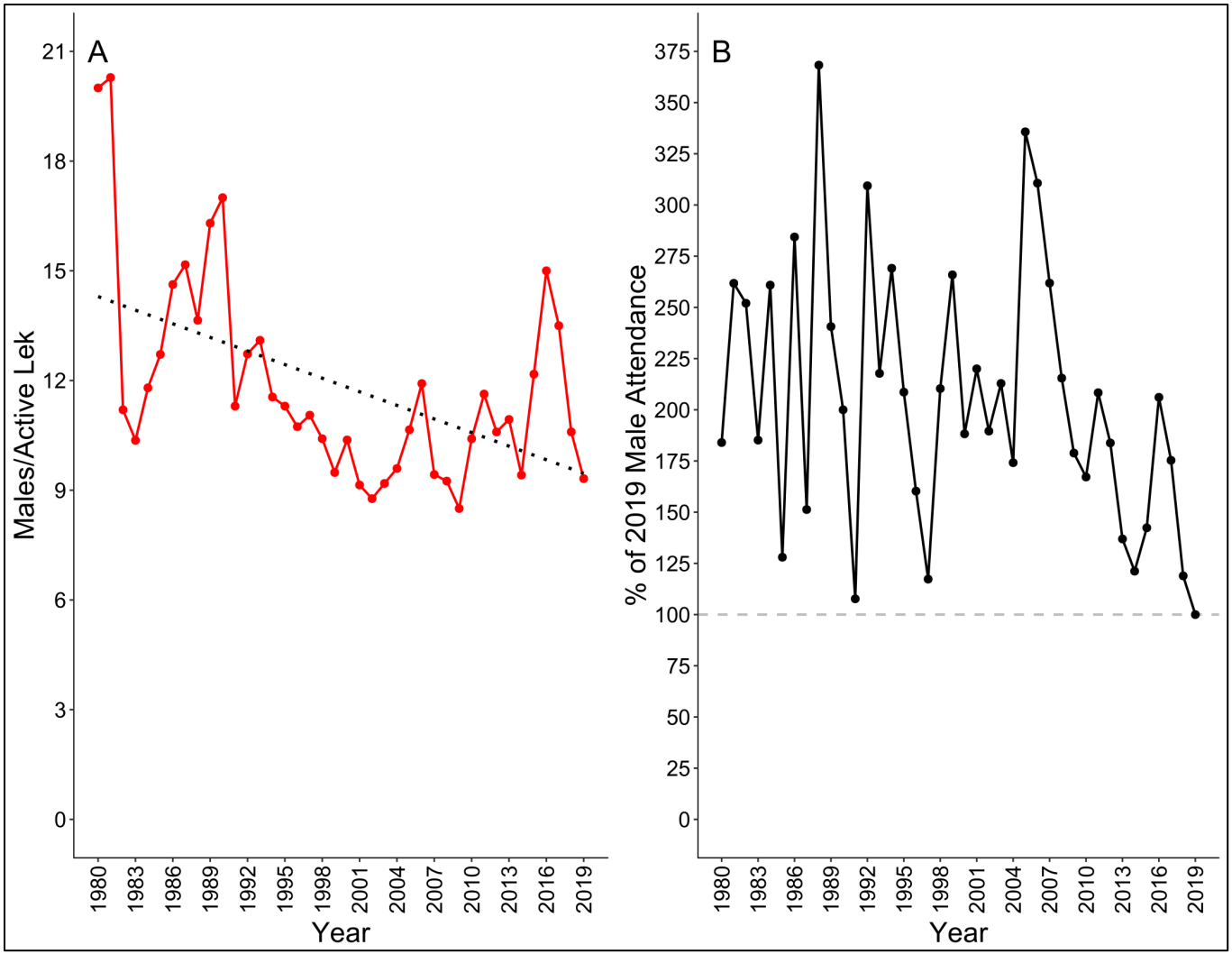


Figure A1.42. Greater sage-grouse population trend **outside of PACs**, 1980 - 2019. A - Change in average greater sage-grouse lek complex size (males per active lek). B - Annual rate of change in male lek complex attendance reported as percentage of 2019 male attendance; annual rate of change in male lek complex attendance calculated only for lek complexes counted in both year *t*, and 2019.

Appendix II - 2019 ODFW Adopt-A-Lek Program Report

Photo by Patrick Lynch

2019 Volunteer Field Report

Southeast Oregon Greater Sage-Grouse Adopt-A-Lek Program

Oregon Department of Fish and Wildlife
Prepared by Damian Fagan

This year marked the 14th year of ODFW's Adopt-A-Lek (AAL) volunteer program. The program provides an opportunity for citizen scientists from Oregon, Washington, and Idaho to count Greater Sage-Grouse (*Centrocercus urophasianus*) leks in remote portions of southern Malheur and Harney counties. Data collected by the volunteers will contribute to ODFW's annual population estimate for the species, which is essential to monitoring the health of the sage-grouse population in Oregon.

This year, 44 dedicated AAL volunteers braved rain, snow, and sunny weather, as well as muddy roads and flat tires to count Greater Sage-Grouse displaying on leks. We welcomed 17 new AAL volunteers to the program hailing from Bend, Dallas, Portland, Prairie City, Eugene, Newport and Salem.

The 2019 lek counting effort in Oregon continued to focus on key habitat areas know as Priority Areas for Conservation (PACs). These PACs contain high priority trend leks, which needed to be counted 3 times between March 15 and April 30, with 7-10 days spaced between each count morning. The AAL program volunteers were assigned to count a total of 9 trend leks this year. In addition, the volunteers were assigned 91 non-trend leks that needed to be counted at least once between March 15 and April 30. The majority of the non-trend leks were counted multiple times to capture a greater data set.

This year, 91 individual sage-grouse leks were counted during 234 count mornings resulting in a total of 898 grouse observed. Additional grouse were observed, but absent during the dawn lek count, either during mid-day lek checks or while observers were driving between sites.

Even though weather and road conditions were at times extremely challenging, AAL volunteers persevered and documented new observation points, lek activity, and lek access. Many volunteers made special efforts to write detailed comments, observations, share photos, and make suggestions to improve the AAL program.

AAL count data add significantly to the statewide Sage-Grouse population database used by state biologists and federal land managers to manage this sagebrush-obligate species. Since 2006, the accuracy of data gathered by the Southeast Oregon AAL volunteers has been strongly correlated with the data obtained from Oregon Department of Fish and Wildlife's staff. Many thanks to the Oregon Wildlife Heritage Foundation and other partners for providing funding and assistance to the AAL program.

A huge THANK YOU to all the AAL volunteers that contributed to this program and who share a deep commitment to the conservation and preservation of this unique and charismatic species.

2019 Volunteer Statistics

- **44 volunteers counted, checked, and surveyed leks**
- **91 individual leks were counted (compared to 71 in 2018, 76 in 2017, 63 in 2016, 46 in 2015, 63 in 2014, and 81 in 2013)**
- **43 individual leks were counted 3 times (compared to 18 in 2018, 17 in 2017, 16 in 2016, 12 in 2015, 0 in 2014, and 0 in 2013)**
- **234 count mornings were conducted (compared to 171 in 2018, 171 in 2017, 116 in 2016, 89 in 2015, 67 in 2014, and 93 in 2013)**
- **53% of the leks counted were active - had birds displaying during the count morning (compared to 51% in 2018, 53% in 2017, 52% in 2016, 72% in 2015, 56% in 2014, and 49% in 2013)**
- **44 leks were not active (no males displaying) on any count morning (compared to 35 in 2018)**
- **47 leks were active (at least 1 male displaying) on a count morning (compared to 36 in 2018, 40 in 2017, 33 in 2016, 33 in 2015, 35 in 2014, and 40 in 2013)**
- **962 total birds were counted (compared to 975 in 2017, 1052 in 2016, 871 in 2015, 453 in 2014, and 468 in 2013)**

- **9 leks were checked but not counted (*great job especially considering the weather*). (compared to 5 in 2018, 2 in 2017, 10 in 2016, 14 in 2015, 34 in 2014, and 35 in 2013)**
- **64% of the active leks counted had 1-10 males (compared to 58% in 2018, 55% in 2017, 42% in 2016, 48% in 2015, and 44% in 2014)**
- **19% of the active leks counted had 11-20 males (compared to 33% in 2018, 18% in 2017, 21% in 2016, 18% in 2015, and 38% in 2014)**
- **15% of the active leks counted had 21 or more males (compared to 14% in 2018, 28% in 2017, 36% in 2016, 33% in 2015, and 15% in 2014)**
- **The largest lek had 49 males (compared to 40 in 2018, 54 in 2017, 60 in 2016, 41 in 2015, and 37 in 2014)**

Funding and support for the 2019 Volunteer Program was provided by Oregon Department of Fish and Wildlife, Oregon Wildlife Heritage Foundation, and Bureau of Land Management.

Appendix III - 2019 Sage-Grouse Wing-Bee Report (2016 Hunting Season Data)

Annual Report – Oregon Sage-Grouse Wing Analyses, 2018

Lee Foster, Sage-Grouse Conservation Coordinator

Executive Summary: Following the 2018 hunting season, 255 greater sage-grouse (*Centrocercus urophasianus*; hereafter: sage-grouse) wings were received from hunters. Production in 2018 (as measured by percent juveniles in the harvest) was 42%, below the long-term average of 47% (1993-2017). The number of chicks per hen was 1.4, an increase from the 2017 production value of 1.0 chicks per hen, but below the long-term (1993-2016) average of 1.5 chicks per hen. Apparent nest success in 2018 was above average based on retention of primary 9 of harvested females (P9 Nest Success: 2018 = 46%, 1993 – 2017 Average = 43%). Production data collected from hunter-harvested wings in 2018 suggests that sage-grouse populations should be stable to declining in 2019.

Overview

In 2018, the sage-grouse hunting season in Oregon was by permit for nine days (8 - 16 Sep), with a daily, and season bag limit of two birds. Season length in 2005-2018 was nine days, versus five days from 1995-2004, and two days in 1993 and 1994. There have not been any changes in daily bag and season limits from 1993-2018 (Braun et al. 2015; Table 1).

Plumage characteristics (e.g. those associated with wings) are used to assess age and gender of numerous game bird species. By assessing plumage characteristics from hunter-harvested wings, demographic parameters (e.g. age structure, sex ratio, and nest success) can be estimated for sage-grouse populations. Sage-grouse wings have been analyzed to gather information regarding population structure and demography in Oregon since 1982. However, methods used to determine age and sex by wing characteristics were refined in 1993. Due to this change in methodology all long-term average rates are calculated only for the 1993 – 2017 period. As in previous years, all hunters who were successful in the controlled sage-grouse hunt drawing were provided envelopes for the return of sage-grouse wings to ODFW. Sage-grouse wings collected during the 2018 hunting season were processed by personnel of Oregon Department of Fish and Wildlife, Bureau of Land Management, and Oregon State University, at an annual Wing Bee in February 2019.

Following the 2018 hunting season, 255 hunter harvested wings were received from the nine wildlife management units (WMUs), where hunting was permitted (Table 2, Figure 1). This represents a decline in wing collection from the previous year (2017 = 270 wings). Wing collection remains below the 25-year (1993-2017) average of 510 wings (Table 3), due to reduction in the number of permits issued. More than 75% of wings (n = 194) were received from only four WMUs (Beatys Butte, Steens Mtn., Warner, and Malheur River); fewer than 10 wings were received from the Owyhee and Silvies WMUs (Table 4). No permits have been offered in the Sumpter or Lookout Mountain WMUs (WMUs 51 and 64 respectively) since 2014

due to concerns about decreasing population trends, and continued uncertainty about the impacts of wildfires (Kitten Complex) that occurred in the summer of 2014 (Figure 1). No permits were offered in that part of the Whitehorse WMU west of Highway 95 and south of the Whitehorse Ranch Road (WMU 68 Subunit 2; Figure 1). No permits have been offered in this area since the 2012 Holloway fire, and the number of permits in the Whitehorse WMU has been reduced in proportion to the area of the WMU closed. The closure continued, in part, to prevent hunting from confounding ongoing research investigating the impacts of the Holloway Fire on sage-grouse in the Trout Creek Mountains. No permits have been offered in that portion of the Wagontire WMU south of the Christmas Valley Highway (South Wagontire, WMU 73B; Figure 1) since 2016 due to concerns about decreasing population trends. No permits were offered in the Juniper WMU (WMU 71) in 2018 due to concerns about decreasing population trends.

Table A3.1. Sage-grouse hunting season dates, lengths, and daily and season bag limits, Oregon, 1993-2018.

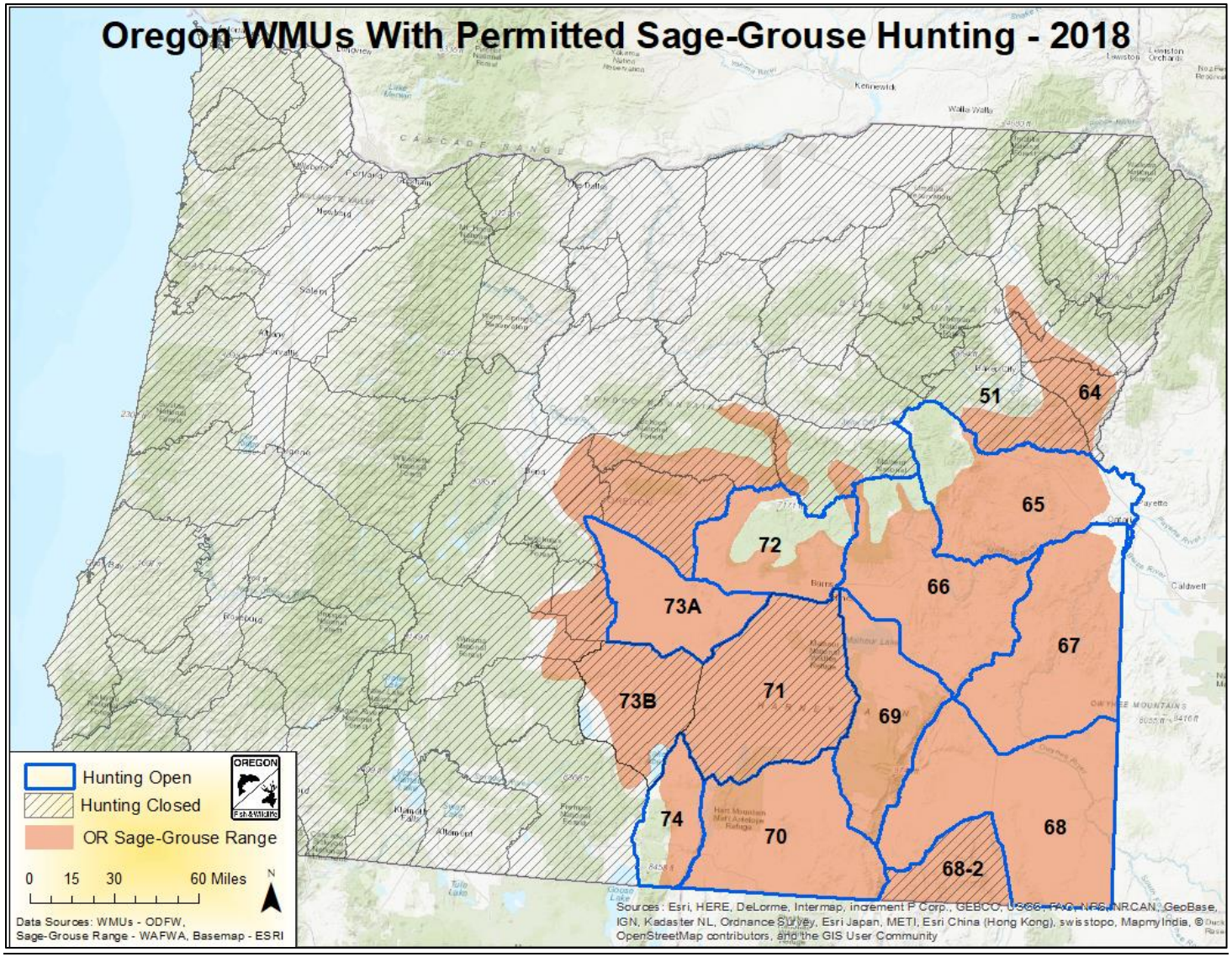
Year	Season Date	No. Days	Daily Bag	Season Limit
1993	18-19 Sep	2	2	2
1994	17-18 Sep	2	2	2
1995	9-13 Sep	5	2	2
1996	7-11 Sep	5	2	2
1997	6-10 Sep	5	2	2
1998	12-16 Sep	5	2	2
1999	11-15 Sep	5	2	2
2000	9-13 Sep	5	2	2
2001	8-12 Sep	5	2	2
2002	7-11 Sep	5	2	2
2003	6-10 Sep	5	2	2
2004	11-15 Sep	5	2	2
2005	10-18 Sep	9	2	2
2006	9-17 Sep	9	2	2
2007	8-16 Sep	9	2	2
2008	6-14 Sep	9	2	2
2009	12-20 Sep	9	2	2
2010	11-19 Sep	9	2	2
2011	10-18 Sep	9	2	2
2012	8-16 Sep	9	2	2
2013	7-15 Sep	9	2	2
2014	6-14 Sep	9	2	2
2015	12-20 Sep	9	2	2
2016	10-18 Sep	9	2	2
2017	9-17 Sep	9	2	2
2018	8-16 Sep	9	2	2

Table A3.2. Oregon wildlife management units with permitted sage-grouse harvest, 2018.

WMU #	WMU Name
65	Beulah
66	Malheur River
67	Owyhee
68[a]	Whitehorse
69	Steens Mtn.
70	Beatys Butte
72	Silvies
73[a]	Wagontire
74	Warner

[a]Unit partially closed to hunting in 2018.

Figure A3.1. Oregon wildlife management units with permitted greater sage-grouse hunting, and the distribution of greater sage-grouse in Oregon, 2018.



Age and Sex Composition

Sage-grouse wings were classified by age (juvenile = hatch year; yearling = second year; adult = after hatch year), based on characteristics of the outer primaries (P10 – P7), first secondary, tertials, and wing coverts (Braun and Schroeder 2015). In areas where the majority of breeding occurs in March and early April, such as Oregon, few yearling males will be identifiable in the harvest due to molt progression (Braun and Schroeder 2015). Additionally, if non-nesting or early nesting yearling females complete their wing molt before harvest, there is no reliable way to differentiate them from after second year adult females (Braun and Schroeder 2015). Thus, in Oregon all after hatch year birds are classified as adults, unless they can be definitively identified as yearlings, by the presence of juvenile P9 and/or P10 (Braun et al. 2015). Sex classification was assigned based on the length of primary 10 and/or primary 9 depending on the condition of the wing (Braun and Schroeder 2015). The number of wings received for individual WMUs was variable (range: 4 - 84 wings), and only 1 of 10 WMUs had >50 wings returned (Table 3). Relatively few yearlings are identified in the harvest in Oregon (25 Year Average = 6% of harvest), and 2018 was no exception with 5% of the harvest classified as yearlings. Overall, the percent of juveniles in the harvest was 42%, representing a slight increase from 2017 (39%). Within individual WMUs, the percent of juveniles in the harvest was variable, likely because of small sample size for many WMUs. The highest level of juveniles in the harvest was in the Warner WMU (59%, 23 of 39 wings), followed by the Steens Mtn. WMU (55%, 22 of 40 wings; Table 4). The sex ratio of juveniles in the harvest (36:64 males to females), was the lowest male:female sex ratio recorded in Oregon since 1982, and was statistically different from the long-term average of 46:54 at an alpha value of 0.05 ($\chi^2 = 3.91$, $p < 0.05$; Table 5). No readily apparent explanation for this highly skewed female sex ratio presents itself, however it may have been related to the severe drought conditions of much of sage-grouse habitat in Oregon during 2018. The lack of juvenile males in the harvest during 2018 suggests that observed males on sage-grouse leks during 2019 may decline more than would be suggested by a 1.4 chicks/female ratio alone.

Table A3.3. Sex composition by age class, and age composition of harvested sage-grouse, all wildlife management units open to harvest, Oregon, 1993-2018.

		Juvenile			Yearling			Adult		
Year	N	M (%)	F (%)	% Harvest	M (%)	F (%)	% Harvest	M (%)	F (%)	% Harvest
1993	439	51	49	47	26	74	4	40	60	49
1994	764	47	53	43	12	88	7	32	68	50
1995	456	42	58	36	5	95	5	32	68	60
1996	493	42	58	51	4	96	5	31	69	44
1997	586	47	53	54	16	84	4	39	61	39
1998	466	48	52	49	6	94	4	39	61	47
1999	671	46	54	56	14	86	5	41	59	39
2000	592	46	54	44	22	78	8	47	53	48
2001	670	50	50	54	10	90	7	44	56	38
2002	648	51	49	58	9	91	7	46	54	36
2003	655	46	54	48	12	88	5	47	53	47
2004	778	45	55	52	9	91	6	40	60	42
2005	829	46	54	45	5	95	5	46	54	50
2006	669	46	54	47	30	70	5	49	51	48
2007	485	44	56	28	10	90	6	38	62	66
2008	443	49	51	54	0	100	4	30	70	42
2009	493	47	53	57	0	100	5	49	51	38
2010	463	43	57	48	4	96	5	36	64	47
2011	422	43	57	42	10	90	5	48	52	53
2012	321	40	60	29	30	70	14	49	51	57
2013	254	50	50	58	11	89	7	36	64	35
2014	264	38	62	31	6	94	6	42	58	63
2015	290	43	57	58	14	86	2	40	60	40
2016	331	54	46	46	32	68	8	45	55	47
2017	270	42	58	39	5	95	7	37	63	53
25-yr Avg.	*510*	*46*	*54*	*47*	*12*	*88*	*6*	*41*	*59*	*47*
2018	255	36	64	42	15	85	5	49	51	53

Table A3.4. Sex composition by age, and age composition of wings from harvested sage-grouse, all wildlife management units with potential sage-grouse harvest, Oregon, 2018.

		Juveniles						Yearlings						Adults					
	Sample	Male		Female		Totals		Male		Female		Totals		Male		Female		Totals	
WMU[a]	Size	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
51[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
64[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
65	14	3	43	4	57	7	50	0	0	2	100	2	14	3	60	2	40	5	36
66	31	4	50	4	50	8	26	0	0	1	100	1	3	12	55	10	45	22	71
67	9	1	33	2	67	3	33	0	NA	0	NA	0	0	2	33	4	67	6	67
68[c]	22	3	43	4	57	7	32	0	NA	0	NA	0	0	2	13	13	87	15	68
69	40	10	45	12	55	22	55	0	NA	0	NA	0	0	8	44	10	56	18	45
70	84	9	28	23	72	32	38	1	14	6	86	7	8	26	58	19	42	45	54
71[b]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
72	4	1	50	1	50	2	50	0	NA	0	NA	0	0	2	100	0	0	2	50
73[c]	10	1	25	3	75	4	40	1	50	1	50	2	20	1	25	3	75	4	40
74	39	7	30	16	70	23	59	0	0	1	100	1	3	8	53	7	47	15	38
UNK	2	0	NA	0	NA	0	0	0	NA	0	NA	0	0	1	50	1	50	2	100
All	*255*	*39*	36	*69*	*64*	*108*	42	*2*	15	*11*	*85*	*13*	5	*65*	49	*69*	*51*	*134*	53

[a]Wildlife Management Unit: 51 - Sumpter, 64 - Lookout Mtn., 65 - Beulah, 66 - Malheur River, 67 - Owyhee, 68 - Whitehorse, 69 - Steens Mtn., 70 - Beatys Butte, 71 - Juniper, 72 - Silvies, 73 - Wagontire, 74 - Warner.
[b]WMU no hunting permits offered in 2018.
[c]WMU partially closed to hunting during 2018.

Table A3.5. Sage-grouse production data as determined from hunter harvested wings, Oregon, 1982 – 1984, 1989 – 1992, 1993 – 2017, and 2018. Data is divided into these periods due to the sage-grouse harvest closure during 1985 – 1988, and the implementation of revised wing analysis methods in 1993.

Year	n	% Juvenile	Chicks/Female	Chicks M:F
1982	73	53	2.4	26:74
1983	291	38	0.9	53:47
1984	144	40	1	42:58
1985- 1988		Hunting Season Closed		
1989	326	41	1.1	46:54
1990	437	34	1	39:61
1991	295	31	0.8	37:63
1992	407	31	0.7	48:52
1982-1992 Mean	*282*	*38*	*1*	*48:58*
1993	439	47	1.4	51:49
1994	764	43	1.1	47:53
1995	456	36	0.8	42:58
1996	493	51	1.5	42:58
1997	586	54	1.8	47:53
1998	466	49	1.5	48:52
1999	671	56	2	46:54
2000	592	44	1.4	46:54
2001	670	54	1.9	50:50
2002	648	58	2.3	51:49
2003	655	48	1.6	46:54
2004	778	52	1.7	45:55
2005	829	45	1.4	46:54
2006	669	47	1.7	46:54
2007	485	28	0.6	44:56
2008	443	54	1.6	49:51
2009	493	57	2.3	47:53
2010	463	48	1.4	43:57
2011	422	53	1.3	43:57
2012	321	29	0.8	40:60
2013	254	58	2	50:50
2014	262	31	0.7	38:62
2015	290	58	2.3	43:57
2016	331	46	1.5	54:46
2017	270	39	1	42:58
1993-2017 Mean	*510*	*47*	*1.5*	*46:54*
2018	255	42	1.4	36:64

Nest Success and Production

Nest success was estimated based on wing molt patterns of adult and yearling females. Female sage-grouse replace primary feathers following completion of nesting activity (Braun and Schroeder 2015); thus hens which nest successfully initiate their molt at a later date than unsuccessful nesters. Wings from hens harvested while they were in the process of growing new primaries through P9 likely had a successful hatch (Braun and Schroeder 2015). Conversely, hens with unsuccessful nests begin molting earlier and generally have a growing primary 10, or have completed their primary molt (Braun and Schroeder 2015). The decision was made to use retention of P9 to estimate apparent nest success. Use of P9 will give a minimum estimate of nest success, but in some years may underestimate actual nest success. Overall, apparent nest success in 2018 was 46%, an increase in apparent nest success from 2017 (32%), and a slight increase from the long-term average (43%). This increase in apparent nest success likely reflects a return to a later average hatch date in 2018 (Table 6). Apparent nest success was highest in the N. Wagontire and Warner WMUs (75%, 3 of 4, and 6 of 8 total females respectively; Table 7).

Connelly et al. (2000) suggested that a chick per hen ratio > 2.25 indicates a healthy, stable or increasing population, but this ratio may be higher than required to maintain some populations and requires further study (Braun 2012). In Oregon the long-term average chick per hen ratio is 1.5. Production in 2018 was below the long-term average, but increased from average production in 2017 (2017: 1.0 chicks per hen; 2018: 1.4 chicks per hen; Figure 2). Within WMUs, nest success was not correlated with either the proportion of juveniles in the harvest (Pearson's Correlation Coefficient = -0.05, $p = 0.55$; Figure 3), or with chicks per hen (Pearson's Correlation Coefficient = 0.11, $p = 0.39$; Figure 3). The increase in average production during 2018 was consistent with the increase in apparent nest success between 2017 and 2018 (apparent nest success 2017: 32%, 2018: 46%). However lack of correlation between apparent nest success and production in Oregon suggests that nest success information derived from plumage patterns is unreliable. This pattern of disagreement between estimated P9 nest success and production as measured by the ratio of chicks per hen in the harvest has always been apparent in the wing data, with no significant correlation between the two values since current data collection began in 1993 (Pearson's Correlation Coefficient = 0.05, $p = 0.41$). Long-term lack of correlation between these two values may suggest that variability in nesting and hatch dates due to climatological factors limits the utility of a single morphometric measure of nest success over time. Current methods for determining apparent nest success may be more useful as a measure of relative date of nesting between years than as a comparison of nest success between years. Further research is needed to develop accurate methods of determining nest success from wing data.

Table A3.6. Sage-grouse nesting success as indicated by retention of at least primary feather P9, all wildlife management units with sage-grouse harvest, Oregon, 1993 – 2018.

Year	Apparent Nest Success (%)
1993	40
1994	40
1995	43
1996	51
1997	*No Data*
1998	30
1999	46
2000	45
2001	49
2002	47
2003	54
2004	35
2005	34
2006	49
2007	35
2008	48
2009	49
2010	37
2011	46
2012	63
2013	47
2014	52
2015	27
2016	30
2017	32
25-Year Average	*43*
2018	46

Table A3.7. Sage-grouse nesting success as indicated by retention of at least primary feather P9, and production rates, all wildlife management units with sage-grouse harvest, Oregon, 2018.

	Estimated Nest Success									Harvest Age Composition			Production	
	Adults			Yearling			All Hens							
WMU	Successful Adult Females (n)	Total Adult Females (n)	Adult Nest Success (%)	Successful Yearling Females (n)	Total Yearling Females (n)	Yearling Nest Success (%)	Successful Females (n)	Total Females (n)	Nest Success (%)	Total Harvest (n)	Juveniles in Harvest (n)	Juveniles in Harvest (%)	Juveniles per Female	Juveniles per Successful Female
Beatys Butte	11	19	58	4	6	67	15	25	60	84	32	38	1.28	2.13
Beulah	0	2	0	2	2	100	2	4	50	14	7	50	1.75	3.50
Malheur River	2	10	20	0	1	0	2	11	18	31	8	26	0.73	4.00
Owyhee	1	4	25	0	0	NA	1	4	25	9	3	33	0.75	3.00
Silvies	0	0	NA	0	0	NA	0	0	NA	4	2	50	NA	NA
Steens Mtn.	3	10	30	0	0	NA	3	10	30	40	22	55	2.20	7.33
Wagontire[a]	3	3	100	0	1	0	3	4	75	10	4	40	1.00	1.33
Warner	5	7	71	1	1	100	6	8	75	39	23	59	2.88	3.83
Whitehorse[a]	5	13	38	0	0	NA	5	13	38	22	7	32	0.54	1.40
Unknown Unit	0	1	0	0	0	NA	0	1	0	2	0	0	NA	NA
All Areas (P9 or lower)	30	69	43	7	11	64	37	80	46	255	108	42	1.35	2.92
All Areas (P10 or lower)	45	69	65	11	11	100	56	80	70	255	108	42	1.35	1.93

[a]WMU partially closed to hunting.

Figure A3.2. Oregon sage-grouse production values (chicks per hen) and 25-year average (dashed line; 1993 - 2017) estimated from hunter harvested wing analyses, 1993 – 2018.

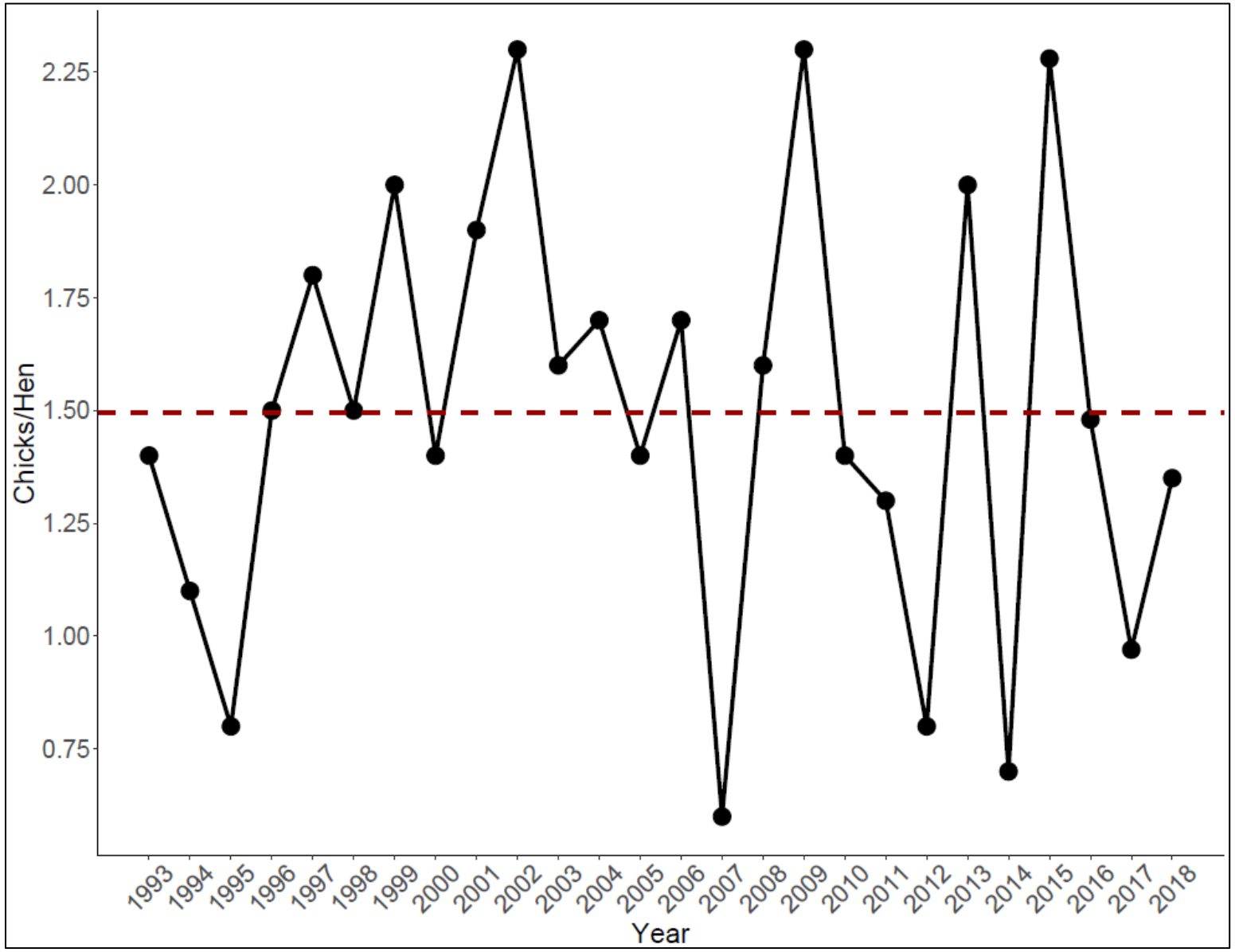
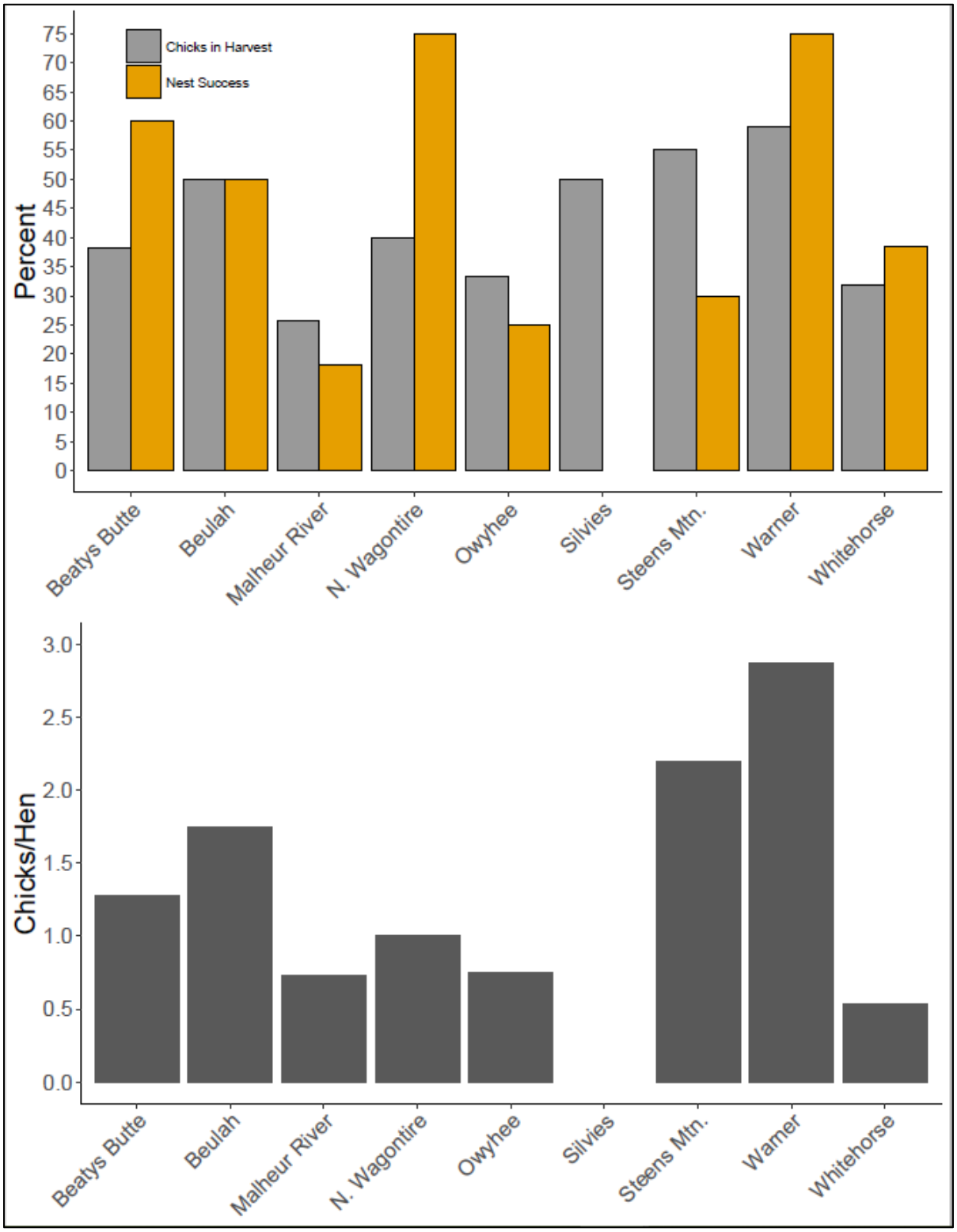


Figure A3.3. Nest success, proportion juveniles in the harvest, and chicks per hen by Oregon wildlife management unit where sage-grouse harvest occurred, 2018. Missing data in Silvies WMU reflects lack of harvested females in 2018.



Hatching Chronology

Where possible, the length of the most recently replaced actively growing adult primary (usually P8 or P7) was recorded for juveniles. Ages of juveniles were calculated using growth data modified from captive-reared sage-grouse (Pyrah 1963). However, there is some evidence to suggest growth rates between wild and captive birds differ. Thus, the estimated hatch dates (Tables 8 – 9) may be up to seven days earlier than the actual hatch date.

Hatching began in early May and lasted through 8 July. Hatching chronology estimates in 2018 agreed with apparent nest success estimates that hatching occurred later in 2018 than the previous three years, with no harvested chicks hatching prior to May 1 during 2018 (2015 – 2017 average: 5%). Unlike during past years (excepting 2014), examination of wings did not indicate a difference in peak hatch between males and females (Table 8; Figure 4).

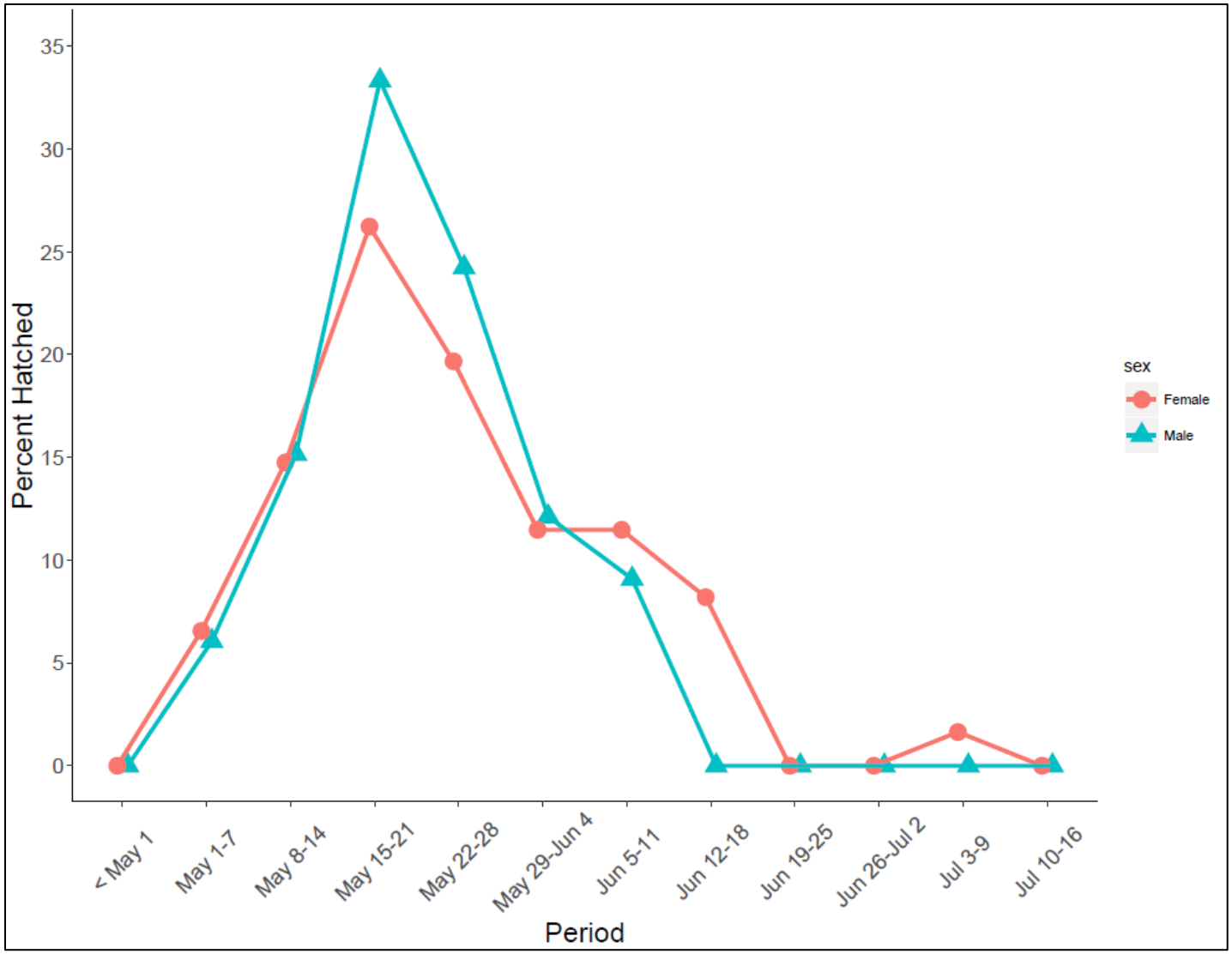
Table A3.8. Estimated hatch dates for juvenile sage-grouse (% of total) from hunter-harvested wings, Oregon 1993 – 2018.

		May					June				July		
Year	N	<1	1-7	8-14	15-21	22-28	29-4	5-11	12-18	19-25	26-2	3-9	10-16
1993	205		1	10	21	18	13	16	13	8	1	1	1
1994	327	1	9	22	18	16	11	12	8	3	1	1	-
1995	163	1	8	13	21	9	8	12	13	6	7	2	-
1996	253	2	9	15	12	14	11	17	10	4	2	3	1
1997	313	8	8	17	15	12	17	15	5	3	1	1	-
1998	229	2	10	13	15	18	14	10	3	7	2	4	1
1999	373	3	5	16	17	16	11	13	8	8	2	1	-
2000	260	7	7	17	18	16	15	14	4	2	1	-	-
2001	359	2	7	13	16	16	17	12	10	5	3	-	-
2002	373	5	6	17	13	21	13	13	4	4	3	1	-
2003	314	4	9	10	15	13	15	13	11	7	4	1	-
2004	398	3	10	24	24	14	11	8	5	2	1	-	-
2005	68	4	9	22	15	9	11	11	9	6	3	2	-
2006	323	1	3	10	12	12	18	21	15	7	1	1	-
2007	135	3	7	16	16	21	15	14	5	2	0	1	-
2008	241	3	7	10	12	15	15	15	8	8	7	-	-
2009	279	3	12	17	21	13	13	11	5	3	1	<1	-
2010	221	<2	6	9	18	13	15	14	13	4	4	<2	-
2011	178	-	<1	6	10	16	13	17	10	13	8	5	3
2012	94	3	5	25	14	16	11	10	11	5	-	-	-
2013	138	4	17	17	20	14	9	9	8	2	<1	-	-
2014	71	8	21	24	14	11	8	6	7	-	-	-	-
2015	152	3	17	28	15	9	14	8	6	1	1	-	-
2016	136	7	11	22	20	22	9	5	3	-	1	-	-
2017	96	6	6	17	21	20	9	11	6	2	1	-	-
2018	94	-	6	15	29	21	12	11	5	-	-	1	-

Table A3.9. Estimated hatch dates, from hunter-harvested wings, for juvenile sage-grouse in Oregon, 2018.

	Males			Females			All Chicks		
Period	n	%	Cumulative %	n	%	Cumulative %	n	%	Cumulative %
< May 1	0	0	0	0	0	0	0	0	0
May 1-7	2	6	6	4	7	7	6	6	6
May 8-14	5	15	21	9	15	21	14	15	21
May 15-21	11	33	55	16	26	48	27	29	50
May 22-28	8	24	79	12	20	67	20	21	71
May 29-Jun 4	4	12	91	7	11	79	11	12	83
Jun 5-11	3	9	100	7	11	90	10	11	94
Jun 12-18	0	0	100	5	8	98	5	5	99
Jun 19-25	0	0	100	0	0	98	0	0	99
Jun 26-Jul 2	0	0	100	0	0	98	0	0	99
Jul 3-9	0	0	100	1	2	100	1	1	100
Jul 10-16	0	0	100	0	0	100	0	0	100

Figure A3.4. Estimated hatch dates of male and female juvenile sage-grouse (% hatched during period), from hunter-harvested wings, Oregon, 2018.



Annual Turnover

Analysis of annual turnover provides a rough estimate of adult mortality, assuming population stability. As during previous years, the data for annual turnover, when based on the proportion of yearlings in the fall harvest, were too marginal for analysis. Few yearlings were identifiable in 2018 (N = 13; 2 male, 11 female), likely due to typically early nesting in Oregon, and a correspondingly early start to the primary molt. Generally, the timing of breeding and nesting in Oregon is earlier than in populations which occur in the eastern portion of the sage-grouse distribution, and at higher elevations (Connelly et al. 2011), leading to an advanced molt in Oregon compared to these other populations. Thus, the proportion of juveniles in the fall harvest of each sex was compared to the proportion of adults and yearlings (combined) of each sex to examine annual turnover (Table 10). This method is valid if one assumes the proportion of juveniles equals the annual loss of yearlings and adults. If the population was stable, annual mortality of adult and yearling males, and adult and yearling females would be 52%, and 43%, respectively (based on the 25 year average; Table 10).

Table A3.10. Estimated annual turnover (%) of adult sage-grouse, assuming population stability, Oregon, 1993-2018.

	Males		Females	
Year	Young	Adults/Yearlings	Young	Adults/Yearlings
1993	54	46	41	59
1994	54	46	36	64
1995	44	56	31	69
1996	60	40	46	54
1997	61	39	49	51
1998	56	44	44	56
1999	60	40	52	48
2000	45	55	43	57
2001	61	39	49	51
2002	64	36	52	48
2003	50	50	47	53
2004	57	43	47	52
2005	47	53	43	57
2006	47	53	48	52
2007	33	67	25	75
2008	68	32	46	54
2009	58	42	55	45
2010	55	45	44	46
2011	42	58	43	57
2012	27	73	31	69
2013	69	31	50	50
2014	31	69	31	69
2015	61	39	56	44
2016	51	49	41	59
2017	45	55	36	64
25-yr Avg	*52*	*48*	*43*	*56*
2018	37	63	46	53

Conclusions

Oregon's sage-grouse hunting seasons are based on a long history of population monitoring and research. The current permit system allows ODFW to closely control legal harvest of sage-grouse. Each year, ODFW projects the fall population of sage-grouse based on lek counts and summer production inventories. In 2018, ODFW estimated there were 18,921 sage-grouse in the fall population in the 9 WMUs where sage-grouse hunting is permitted, and offered 740 permits, of which 442 permits were issued, and an estimated 402 individuals chose to hunt (Table 11). ODFW has a self-imposed policy not to harvest more than 5% of the fall population, with harvest usually estimated at around 3% of the fall population. This harvest strategy is well within the guidelines suggested by the Western Association of Fish and Wildlife Agencies (Connelly et al. 2000). In addition, it is well below the <11% harvest rate identified as unlikely to influence sage-grouse populations in Nevada and Colorado (Sedinger et al. 2010).

- Compared to other states that offer a sage-grouse hunting season, Oregon's hunting season is likely the most conservative:
- Oregon's sage-grouse season is limited-entry for each WMU;
- Sage-grouse are not hunted range-wide in Oregon. Hunting is permitted in only 9 of 21 WMUs where sage-grouse occur (Figure 1);
- Permit numbers are allocated to take no more than 5% of the fall population (3% or less in practice);
- Each permit holder is allowed only 2 sage-grouse per season;
- In 2018, estimated harvest of sage-grouse was 412 birds, 2.2% of the estimated 18,921 sage-grouse in potential hunt areas.

Through the collection of hunter-harvested wings, Oregon's sage-grouse hunting season provides crucial demographic data regarding the structure of sage-grouse populations in Oregon. This data would be costly or unfeasible to collect through other means. During 2015 and 2016, harvest and wing returns were concentrated in four southern WMUs, limiting demographic inference in the northern portion of sage-grouse range in Oregon. In 2017 and 2018, additional harvest in the Malheur River WMU helped extend demographic inference towards the northern portion of the species range in Oregon.

Table A3.11. Estimated fall sage-grouse population, maximum allowable harvest, hunter statistics, and permit allocation in Oregon wildlife management units where sage-grouse harvest is permitted, 2018.

WMU	Estimated Fall Population	Harvest Limit (5%)	Birds/Hunter[a]	Hunter Participation Rate[a]	2018 Permits
Silvies	1072	54	0.61	0.57	20
North Wagontire	644	32	0.61	0.57	20
Beatys Butte	3851	193	1.17	0.74	150
Steens Mtn.	2119	106	1.17	0.74	75
Warner	2419	121	1.17	0.74	80
Beulah	2479	124	0.62	0.26	150
Malheur River	2425	121	0.62	0.26	100
Owyhee	1118	56	1.25	0.46	75
Whitehorse	2233	112	1.25	0.46	70
Total	18921	1003	-	-	740

[a]Hunter statistics based on average from hunter harvest survey by Data Analysis Unit (DAU) for years 2013 – 2017.

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Appendix IV - 2019 Aerial Lek Search Summary

ODFW conducts annual helicopter lek searches, currently made possible through funding support by the Oregon/Washington BLM, in order to locate previously undocumented leks, document shifts in sage-grouse breeding distribution, and check activity of leks which are inaccessible from the ground. Lek searches are conducted from ½ hour before to 2 hours after sunrise, following fixed transects separated by ¼ - ½ mile. During searches the helicopter maintains an altitude of 50 – 150 feet above ground level, and a speed of approximately 60 mph. Helicopter searches and surveys are primarily directed towards the assessment of lek occupancy, as lekking sage-grouse are sensitive to aerial predators, and thus often limit display behavior in presence of a helicopter. For this reason, following the discovery of previously unknown leks, ground observation of a site is required to confirm lek occupancy and attendance. Counts conducted from a helicopter are generally not used to estimate population trend in an analysis area, but rather act as presence-only assessments of lek activity, and to assign leks to size strata. The exception to this rule is when male counts conducted from a helicopter are greater than follow up counts conducted by a ground observer. In these cases, the aerial counts are used to both assess population trend and assign leks to size strata.

During 2019, ODFW conducted 115 hours of helicopter lek searches in the Brothers PAC and surrounding low density habitat in Deschutes, Crook, and Lake County. Approximately 4,000 miles of transects were flown (Figures A4.1) over the course of 18 days utilizing 3 helicopters. No new leks were located in the Brothers PAC, and only 1 new lek was identified in the Low Density Habitat surrounding the PAC.

Aerial surveys began on 16 March, similar to start dates in previous years, however due to late winter snow remaining present in the survey area, surveys were delayed after the 18 March for 2 weeks. Surveys began again on 31 March and continued through 13 April. Unfortunately, weather, particularly light rain and fog hampered much of the survey period in April. The combination of snow during the first 4 days of surveys, and light sporadic rain during the remaining surveys likely reduced sage-grouse detectability and lek attendance. Thus portions of this survey area will be resurveyed during the spring of 2020.

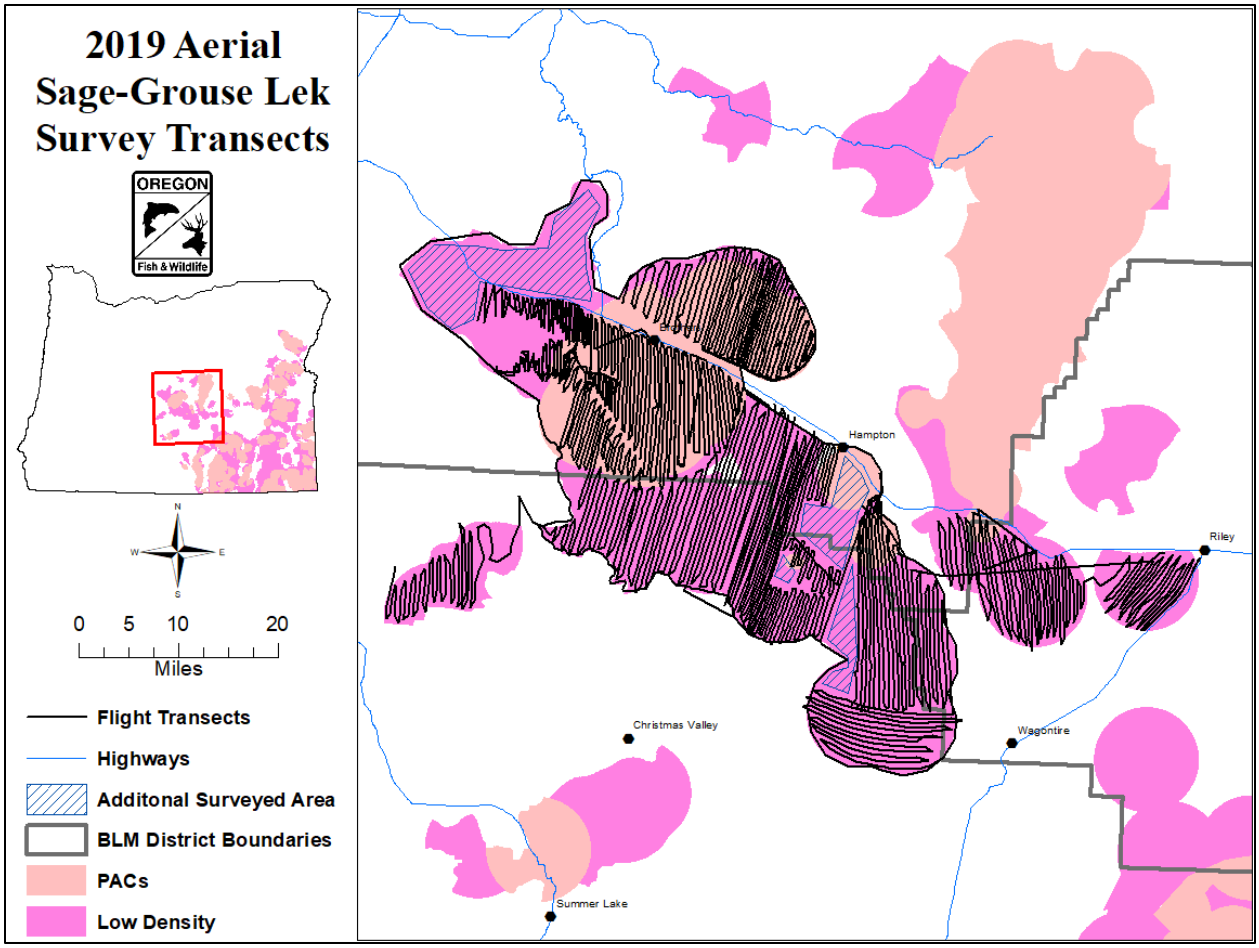

Figure A4.1. Greater sage-grouse aerial lek search transects in the Brothers PAC and surrounding low density habitat, 2019.